

Acknowledgements

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Executive Summary

Energy efficiency and renewable energy are the new frontiers of the clean energy economy. With Utah's pioneering spirit, our State embodies the resourcefulness and innovation needed to thrive and prosper in this new frontier. These emerging market opportunities are increasingly important as we seek means to spur economic development, diversification and job creation.

Renewable energy and energy efficiency are critical components of Utah's energy portfolio, and the State has two goals to significantly expand the use of these resources over the next several years:

- In 2006, former Governor Jon Huntsman Jr., called for a 20 percent increase in energy efficiency across all sectors by 2015;¹
- In 2008 the *Energy Resource and Carbon Emission Reduction Initiative* was signed into law and established a target for Utah to derive 20 percent of its electricity sales from renewable resources by 2025.²

This study was conducted at the request of the Governor's Energy Advisor, Dr. Dianne Nielson, to analyze the net economic development effects on the State of Utah if it were to achieve a 20 percent increase in energy efficiency by 2015 and 20 percent of electricity sales from renewable resources by 2020 ("20% Clean Energy Scenario" - described in further detail below).³ According to this macroeconomic analysis, new investments in energy efficiency and renewable energy in the state of Utah will result in:

- Nearly 7,000 net new ongoing jobs in the state by 2020;
- \$310 million in net new annual earnings; and
- \$300 million net annual increase in gross domestic product by state (GDPS).

For comparison, the Utah ski industry contributed about \$440 million to state GDPS in 2008.⁴

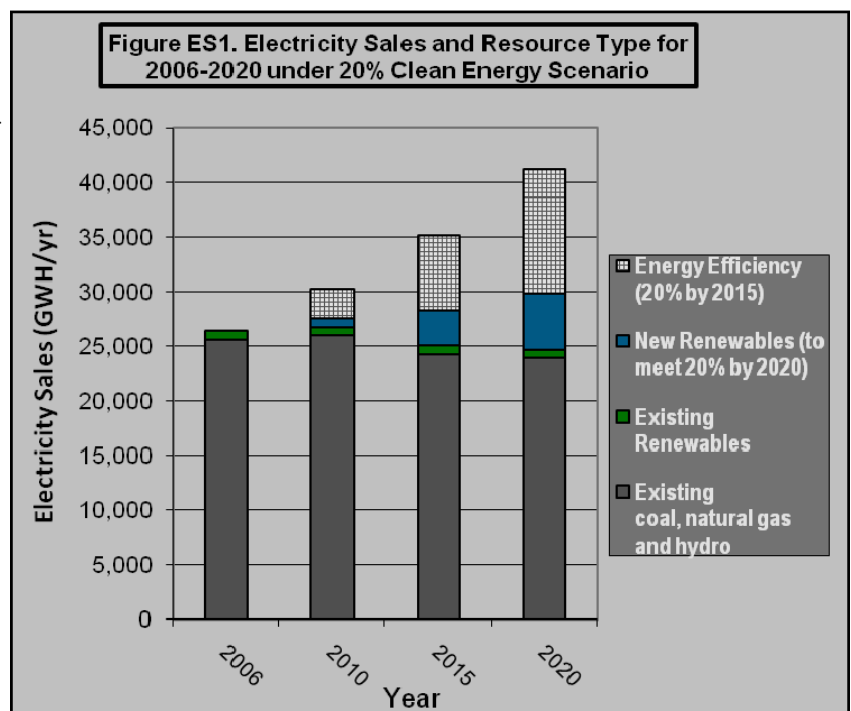
The benefits estimated in this analysis are likely conservative because it assumes that the production and use of renewable energy and

increased energy efficiency addresses only the demand within the state's borders and does not model the economic benefits if Utah becomes a leader and exporter of products, goods and services related to clean energy industries.

This study does not include an analysis of the impact to utility rates. This could be addressed in future economic analyses.

This study analyzes the *net* effects on jobs and economic development as a result of achieving the 20% Clean Energy Scenario. Any job losses or shifts in economic activity that result from increased renewable energy and/or energy efficiency are discussed in the report and accounted for in the net numbers for jobs and economic development impacts.

The 20% Clean Energy Scenario modeled in this study meets the projected energy demand growth through 2020 with new energy efficiency and renewable energy resources, and includes some simple cycle gas resources to balance the system. This scenario assumes that nearly all existing electricity resources currently serving Utah's customers will still be on-line in the year 2020 (see Figure ES-1).



The New Frontier: Energy Efficiency and Renewable Energy

Utah’s energy efficiency and renewable energy technical resource potential is well beyond what is needed to achieve the state’s adopted goals.^{5,6,7}

Energy efficiency is a resource that can be “mined and developed” in every new (and most existing) commercial building, home, industrial operation, and government facility. Every new construction project or retrofit has the potential to increase efficiency over standard practices, which helps Utah citizens and businesses save energy and money today and into the future. These savings are reinvested into the economy and lead to more job creation and economic development.

Renewable energy resources complement and help diversify Utah’s existing electricity resources while creating new opportunities for jobs and economic development, especially in Utah’s rural communities. The renewable energy resources modeled in this study are predominantly wind and geothermal, with some solar and biomass resources.

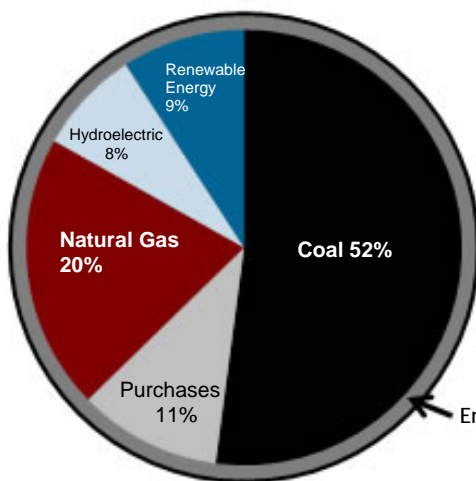
Scenarios Modeled and Evaluated

This study models two distinct energy portfolio scenarios in the year 2020 (see Figure ES-2) and uses a Utah State projected employment baseline for comparison:⁸

- **Reference Scenario:** This scenario reflects 2007 utility resource planning documents.⁹ It is based closely on PacifiCorp’s 2007 electricity resource planning documents and treats the entire state of Utah as if it follows PacifiCorp’s electricity plan through the year 2020.¹⁰ By 2020, this scenario develops new natural gas plants, 9% renewable energy (mostly wind from Wyoming) and a modest amount of energy efficiency through utility demand side management (DSM) programs. This scenario also assumes a continuation of Questar Gas’s energy efficiency programs at 2007 funding levels.
- **20% Clean Energy Scenario:** This scenario represents significantly more renewable energy and energy efficiency measures than the Reference Scenario. In this model, renewable energy represents 20 percent of Utah electricity sales in 2020 and

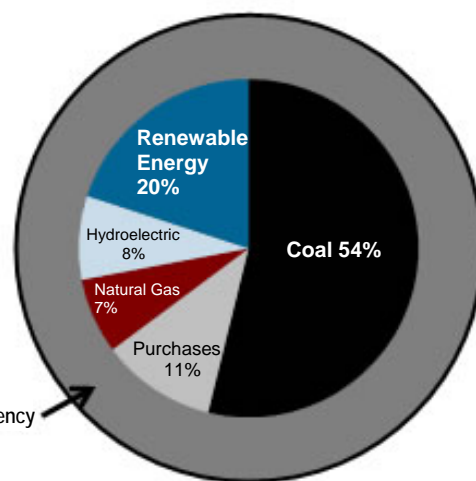
Figure ES-2. Electricity Mix for Each Scenario

Reference Scenario Electricity Mix



Supply-side Electricity: 38,285 GWh
 Energy Efficiency: 2,886 GWh
 Total Electricity: 41,171 GWh

20% Clean Energy Mix Scenario Electricity Mix



Supply-side Electricity: 29,817 GWh
 Energy Efficiency: 11,354 GWh
 Total Electricity: 41,171 GWh

Energy Efficiency

KEY: Black circle - Total energy needed by 2020 (41,171 GWh); Pie charts - supply-side resources and percentages; Gray ring - energy efficiency that reduces electricity demand. All areas drawn to scale.

energy efficiency is increased statewide 20 percent by 2015. Those energy efficiency investments are extended to the year 2020. Only a portion of the energy efficiency measures in this scenario come from utility DSM programs; the additional energy efficiency improvements come from other measures, such as building efficiency upgrades and lamp and appliance efficiency standards. Electricity savings are approximately three times higher than in the Reference Scenario, and the natural gas savings are approximately six times higher. This scenario assumes no change in demand for coal mining and natural gas drilling as compared to the Reference Scenario, since existing coal generation remains online and regional demand for natural gas should offset decreased Utah demand.

(2020) impact from full implementation of the model scenarios, *not* the cumulative total of all impacts realized over the 14 year period (2007-2020) analyzed in the study.

The analysis of the year 2020 captures the following: construction-related impacts associated with developing projects in and around the year 2020; the impacts of ongoing operation and maintenance of projects installed from 2007-2020; and the impacts of energy *savings* from energy efficiency measures installed from 2007-2020.

Renewable Energy and Energy Efficiency Create Jobs and Stimulate New Economic Development

As Table ES-1 shows, the 20% Clean Energy Scenario provides a net increase in jobs, earnings, and GDPS over the Reference Scenario, stimulating new economic development for Utah.

Jobs

The 20% Clean Energy Scenario estimates nearly 7,000 more net ongoing jobs by 2020 than the GOPB Baseline predicts. This job growth, led by the construction and service industries, also includes a variety of high-tech positions for engineers, technicians, installers and electricians. The net increase above the Reference Scenario is over 4,000 jobs.

Earnings

The 20% Clean Energy Scenario provides net annual earnings of \$310 million by 2020. The net increase over the Reference Scenario is more than \$140 million.

The Governor’s Office of Planning and Budget (GOPB) releases an annual report that presents anticipated employment by sector in 2020, as well as expected changes in the structure of Utah’s economy over time.¹¹ The job creation resulting from the above scenarios are compared to this baseline (hereinafter referred to as **GOPB Baseline**).

Utah’s Economy in 2020

The input-output modeling in this analysis incorporates Utah-specific multipliers derived from the IMPLAN Social Accounting & Impact Analysis Model. The IMPLAN model captures economic activity as a ratio of the total change in economic activity in the region relative to the final demand changes in one or more sectors.

The results presented in this study are the single-year

Table ES-1. Jobs and Economic Development by 2020:						
Reference Scenario Compared to 20% Clean Energy Scenario						
	Jobs		Earnings (\$Millions)		GDPS (\$Millions)	
	Net Total over GOPB Baseline	Net over Reference Scenario	Net Total	Net over Reference Scenario	Net Total	Net over Reference Scenario
Reference Scenario	2,800	N/A	\$160	N/A	\$280	N/A
20% Clean Energy Scenario	6,890	4,100	\$310	\$140	\$300	\$20

Note: All dollar amounts are 2008\$. The Clean Energy Scenario assumes no additional change in demand for coal mining and natural gas drilling as compared to Reference Scenario.

Gross Domestic Product by State (GDPS)

In the 20% Clean Energy Scenario, the renewable energy industry is projected to increase Utah's annual GDPS by about \$300 million by 2020. This figure is comparable to the Utah ski industry, which contributed about \$440 million to state GDPS in 2008,¹² suggesting that growing the renewable energy and energy efficiency sectors can play a substantial role in Utah's economy. The net annual increase in GDPS above the Reference Scenario is expected to be \$20 million by 2020. This more energy-efficient economy represents a shift from capital intensive spending by utilities (i.e., investments in large fossil fuel power plants) to more labor-intensive spending on efficiency measures (installed primarily by Utah businesses employing Utah workers).

Investments

The 20% Clean Energy Scenario will require an estimated investment of \$8.9 billion over the 14-year period (2007 – 2020), or \$500 million more than the Reference Scenario (see Figures ES-3 and ES-4). Since the Reference Scenario was based on a multi-state regional planning document, the amounts noted here reflect only Utah's share of the cost of the investments for both scenarios in order to facilitate direct comparisons between the two scenarios.

The 20% Clean Energy Scenario invests approximately 93 percent of total expenditures in up-front capital investments, with only 1 percent invested in ongoing fuel costs. The Reference Scenario will require an estimated investment of \$8.4 billion over the 14-year period, with 33% invested in ongoing fuel costs and an additional 2% on

purchases (year 2020 only). Both scenarios invest approximately 6-7% of total costs on operations and maintenance.

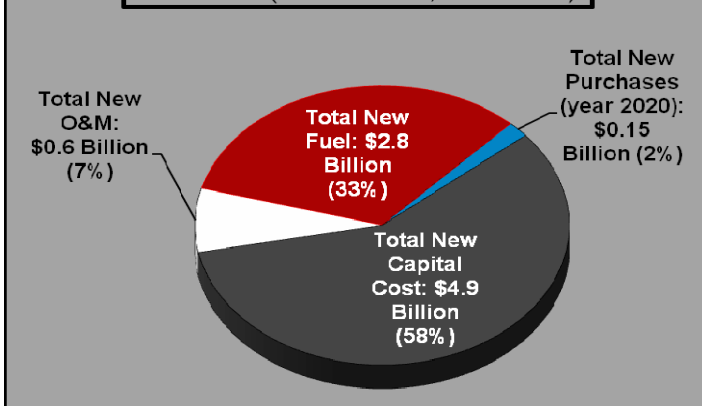
Conclusion

The 20% Clean Energy Scenario projects the creation of nearly 7,000 net ongoing jobs by 2020 compared to the GOPB Baseline. For a similar level of investment, the 20% Clean Energy Scenario results in a net increase of 4,100 jobs, \$140 million of annual earnings and a \$20 million annual increase in GDPS relative to the Reference Scenario. The increase in jobs is due to the investments in renewable energy resources, designing, building and retrofitting energy efficient homes and businesses, and an increase in local spending as a result of energy bill savings. Furthermore, the 20% Clean Energy Scenario provides a hedge against volatile fuel costs and future risks and uncertainties in a rapidly changing energy market.

This study presents a modest share of Utah's potential for new clean energy development, suggesting that the 20% Clean Energy Scenario is an excellent first step in meeting Utah's growing energy demand while mitigating carbon and fuel price risks to Utah businesses and citizens.

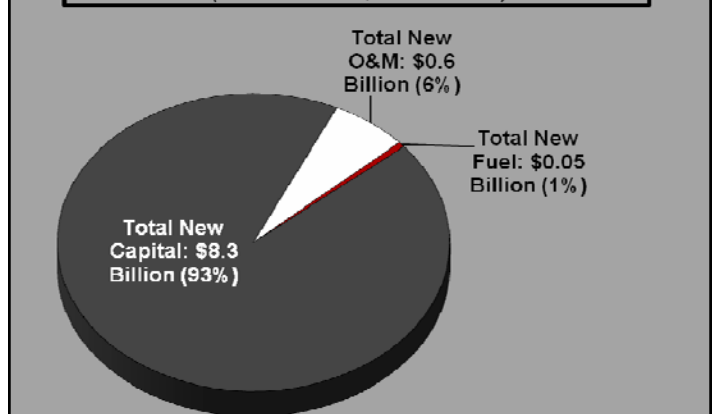
Through innovation, leadership and aggressive programs and policies to advance energy efficiency and renewable energy will help make Utah a leader in the new clean energy economy, while generating new high-quality jobs and economic development in Utah's rural and urban areas.

Figure ES-3. Reference Scenario: Approximate Investment Costs for New Resources (Utah's Share, 2007-2020)



Note: The amounts presented are Utah's share of the cost of the investment since the Reference Scenario was based on a regional planning document.

Figure ES-4. 20% Clean Energy Scenario: Approximate Investment Costs for New Resources (Utah's Share, 2007-2020)



Note: The amounts presented are Utah's share of the cost of the investment to directly compare with the Reference Scenario.

Introduction

Clean energy is the new frontier of the energy economy, and energy efficiency and renewable energy remain among the fastest growing industries in the U.S. and the world. These homegrown energy resources are also strengthening our national energy supply, providing a critical hedge against risks and volatility in the energy market, while creating American jobs that cannot be outsourced and stimulating the economy in a time when it is needed most. When combined, the renewable energy and energy efficiency industries represented \$1.04 trillion in U.S. revenue in 2007, more than the combined sales of the three largest U.S. corporations - Wal-Mart, ExxonMobil, and General Motors (\$905 billion).¹³

Sustained growth in the clean energy sector is generating significant job creation and investment across the U.S. The Pew Charitable Trusts reports that clean energy employed a total of 770,000 people in 2007, including the recycling and transportation sectors.¹⁴ According to the

American Wind Energy Association, approximately 85,000 people were employed in the U.S. wind industry in 2008 (up from 50,000 in 2007),¹⁵ and the U.S. wind energy industry invested approximately \$17 billion into the economy and installed over 8,000 megawatts (MW) of new generating capacity (enough to serve over 2 million homes) in 2008.¹⁶ Utah's neighboring state, Colorado, recently attracted three new wind manufacturing facilities that will create over 2,300 new local jobs. Following similar growth trends, the capacity of annual U.S. solar installations doubled between 2005 and 2007.¹⁷ Clearly, there is significant growth in the clean energy sector, and even in the current recession, there are expectations of continued growth due to the investments in clean energy by the American Recovery and Reinvestment Act of 2009 (the federal stimulus bill).


With growing energy demand, increasing risks and uncertainties in the energy market, and new means to stimulate the economy on the horizon, renewable energy and energy efficiency are increasingly critical components of Utah's energy portfolio. Across Utah, clean energy projects are already creating jobs, generating investments in local economies, and providing significant energy (and financial) savings to Utah citizens and businesses. With

Utah's pioneering spirit, our State embodies the resourcefulness and innovation needed to thrive and prosper in the new frontier of clean energy.

To that end, the State has two goals to expand the use of these resources significantly over the next several years:

- In 2006 former Governor Jon Huntsman, Jr., called for a 20 percent increase in energy efficiency across all sectors by 2015;¹⁸ and
- In 2008 the *Energy Resource and Carbon Emission Reduction Initiative* was signed into law and established a target for Utah to derive 20 percent of its electricity sales from renewable resources by 2025.¹⁹

As we work towards these goals and foster in-state clean energy markets, Utah has the opportunity to spur economic development, diversification, and job creation.



Utah has tremendous potential for economic growth through energy efficiency and renewable energy development.

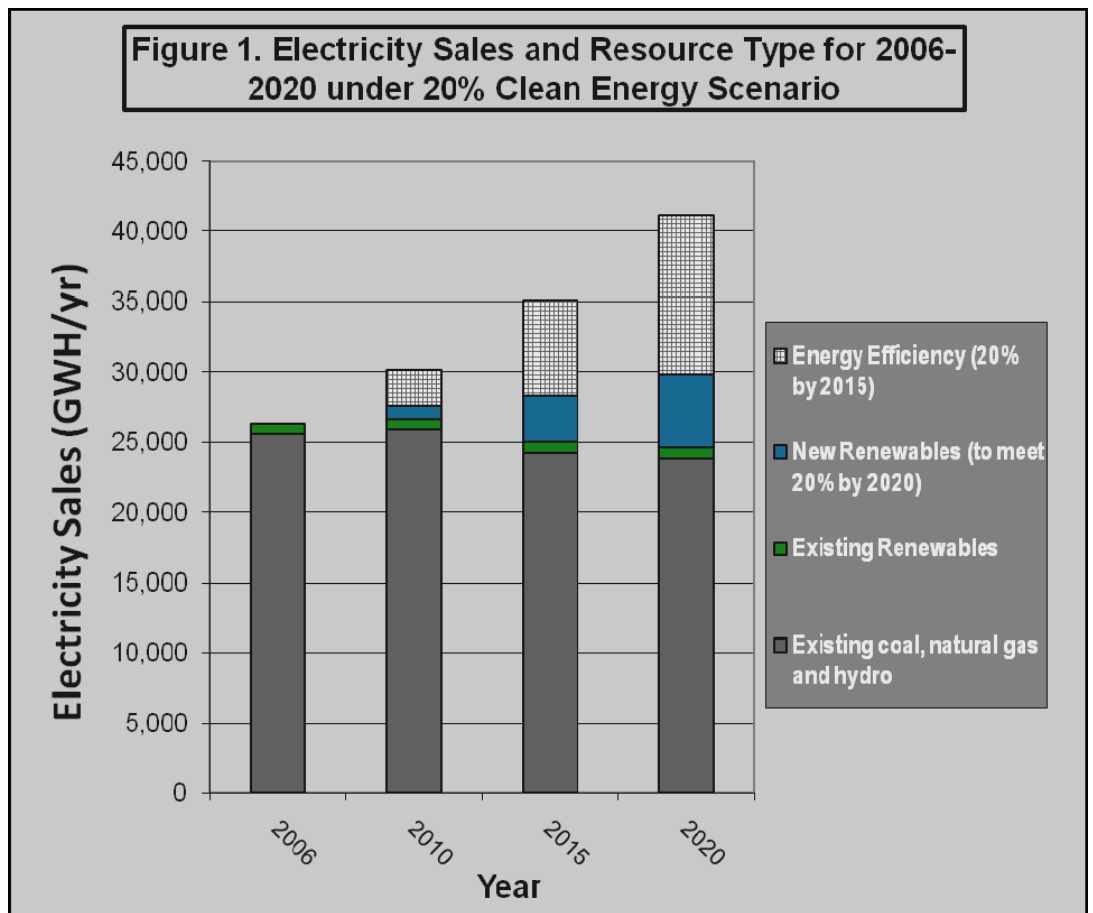
Study Framework

This study was conducted at the request of the Governor's Energy Advisor, Dr. Dianne Nielson, to analyze the net economic development impacts to the State of Utah if it were to achieve a 20 percent increase in energy efficiency by 2015 and 20 percent of electricity sales from renewable resources by 2020 ("20% Clean Energy Scenario" - described on page 17 of this report).²⁰ The target date for the state renewable energy goal was accelerated by five years to 2020 to more closely coincide with the available quantified efficiency data, projected in-state electricity sales growth and capacity requirements.^{21,22,23}

The amount of energy efficiency and renewable energy modeled in this study is approximately equal to the projected increase in demand for electricity by 2020. As such, nearly all of the current (2006) electricity resources will still be necessary to help meet electricity demand in the year 2020 (see Figure 1). This scenario assumes no additional change in demand for coal mining and natural gas drilling for 20% Clean Energy Scenario as compared to Reference Scenario since coal generation remains online and regional demand for natural gas should offset decreased Utah demand.

As we move to a more energy efficient economy with increased renewable energy development, Utah's economy will undoubtedly experience transformations across all sectors. This study evaluates the net impacts of these transformations, including those projected in traditional energy sectors and other industries.

As national and global demand for clean energy continues to increase, Utah's ability to adapt to a changing energy market and identify opportunities for innovation and leadership will benefit the economy on numerous levels. This study is the first step in understanding these opportunities and the role Utah can play in the new frontier of the clean energy economy.



“The potential growth in Green Jobs is significant in that it could be the fastest growing segment of the United States economy over the next several decades and dramatically increase its share of total employment. The current count ... amounts to less than one-half of a percent of total current jobs. The [future] generation ... would more than quintuple the total count and could provide as much as 10 percent of new job growth over the next 30 years.”

-----Global Insights
Report to National Council of Mayors

Provo Company on the Fast Track to Geothermal Development in Utah

In 2008, Raser Technology, Inc. constructed a 10 MW geothermal power plant in Beaver County, Utah in only six months using a new proprietary modular power plant design.¹ The project, named after Utah's Senator Orrin G. Hatch, is the first geothermal plant to be built in Utah in 20 years; the power will be sold to the city of Anaheim, California.² "Raser Technologies is a company that has consistently pushed the envelope to develop and bring to market some of our nation's most advanced concepts in clean energy. Geothermal is clean and green, and it's abundant, especially in Utah," commented Senator Orrin Hatch.³

In addition to generating clean base load electricity, Raser is creating new jobs and opportunities in Utah. During the construction phase, the project created the equivalent of 70 full time construction jobs in the Beaver County area. Currently six full time employees operate the Beaver County plant and Raser employs 26 at their Provo headquarters to support their geothermal ventures. Raser plans to increase the capacity of the Orrin G. Hatch Power Plant by 50% in early 2009 and is working on other Utah projects.⁴



Raser Technologies' Thermo Power Plant in Beaver County, Utah.

(credit: Raser Technologies)

Quick Facts:

Jobs: 70 construction, 26 development and 6 operations and maintenance

Project: Orrin G. Hatch Geothermal Power Plant (Thermo Power Plant)

Company: Raser Technologies, Inc. (headquartered in Provo, Utah)

Location: Beaver County, Utah

Equipment: 50-280 kW binary cycle generators from UTC Power.

Resource technology: Geothermal

Project construction cost: \$35 million

Annual revenue: \$6.5 million

Currently capacity: 10 MW

Potential capacity of larger resource: 238 MW

Power purchaser: City of Anaheim, California

¹Raser Completes First Commercial Geothermal Power Project In Utah In Over 20 Years And Schedules Ribbon Cutting Ceremony And Press Conference. October 23, 2008. Press Release. Raser Technology Inc.

<http://www.rasertech.com/news/scripts/full-news.php?1224767100>

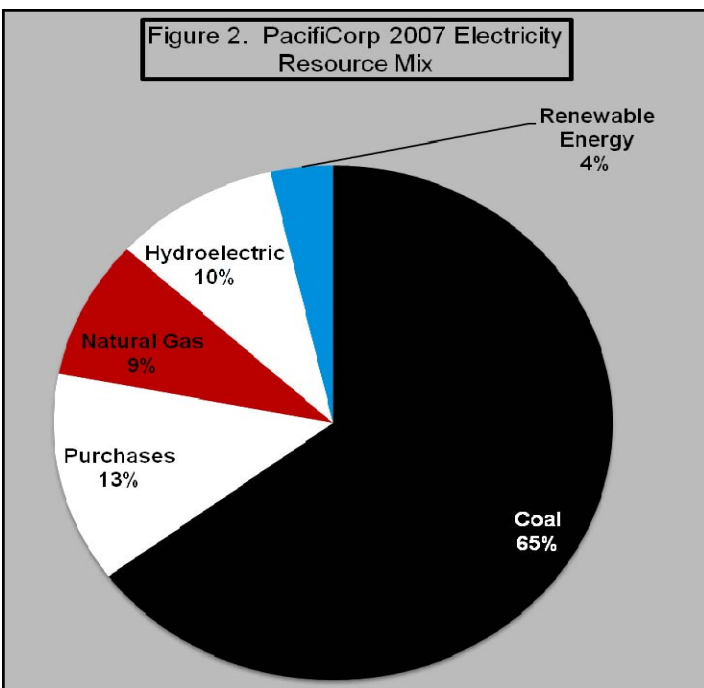
² Ibid.

³ Ibid.

⁴ Phone Conversation with Layne Ashton, Business Development Director. Raser Technology Inc., January 6, 2009.

Energy Efficiency and Renewable Energy: THE NEW FRONTIER

In 2006, 97.7 % of electricity generated in Utah was from traditional coal, natural gas, and petroleum resources, with renewable resources including hydropower, contributing only 2.3 percent.²⁴ However, this number includes the electricity generated for export to states like California, and does not account for the fact that 80% of Utah receives electricity from Rocky Mountain Power, a subsidiary of PacifiCorp, which is a regional electricity provider with a more diversified electricity mix (see Figure 2).



Note: Purchases are a combination of natural gas and hydroelectric electricity. Since 80% of Utah receives its electricity from Rocky Mountain Power, a PacifiCorp subsidiary, Utah's electricity use by resource more closely matches this mix.²⁵

This study analyzes electricity sales, not generation, for an electricity resource mix that more closely resembles that shown in Figure 2.

Currently, only 4% of the electricity needs of Utah residents and businesses is generated from renewable resources, and almost entirely from Rocky Mountain Power. However, with the state's aforementioned goals to increase the use of renewable energy and energy efficiency,²⁶ Utah is starting to grow these sectors. Utah offers incentives for renewable energy, the utilities have robust energy efficiency programs, and there is strong interest statewide to become a leader in energy efficiency and renewable energy to put Utah on the forefront of this emerging energy market. In his 2009 State of the State Address, former Governor Jon Huntsman Jr. enthusiastically stated:

Just as Wall Street is known for finance and Silicon Valley for technology, by 2012, I believe Utah can become the premier destination in America for renewable energy! And don't tell me it can't be done! ... We will be the epicenter for energy development - but we must have the land, transmission, and regulatory framework to make it a reality. We must look beyond 20th century mentalities and bet on 21st century realities.²⁷

The following is a description of the energy efficiency and renewable energy technologies and programs modeled in this study.

Economic Development Corporation of Utah – Growing and Recruiting Utah's Clean Energy Industries

Economic Development Corporation of Utah (EDC Utah) is a public/private partnership that works with state and local governments and private industry to attract and grow competitive, high-value companies and spur the development and expansion of local Utah businesses.¹ EDC Utah is currently focusing its recruiting efforts on eight targeted sectors, or cluster; as of 2009, the energy cluster had the most active projects (22 out of 72 total projects).²

Over the past two years, over 60 percent of the energy sector projects have been related to clean energy projects, such as the manufacturing of renewable energy, recycled material and electric vehicle components.³ One in five energy cluster projects are solar manufacturing companies - on average each solar manufacturing project creates over 800 jobs and a total of over \$570 million in state investments.⁴

¹Source: Samantha Julian, Business Development Manager for the Economic Development Corporation of Utah. January 2009. URL: www.edcutah.org/

WHAT IS ENERGY EFFICIENCY?

Energy efficiency means using less energy to provide the same (or better) energy service. A resource that can be developed like any other natural resource, energy efficiency is achieved primarily through adoption of more efficient technologies or processes.

Energy Efficiency - Smart Energy Saving Utahns Money

As a matter of everyday practice, Utah residents and businesses look for ways to save money and to run their businesses more efficiently; this is especially true during the current economic recession. Though often overlooked and undervalued, energy efficiency is a tremendous untapped resource that can be “mined and developed” in every new and most existing commercial building, home, industrial operation, fleet, and government facility. Energy efficiency not only creates jobs and economic development, but also keeps more money in our pockets by providing significant savings to Utah families, businesses, and governments.

Energy efficiency is often misunderstood as energy conservation, but the two are distinct. Energy conservation is achieved through changing personal behavior to save energy; for example, turning off the lights when you leave the room. Energy efficiency, by contrast, is technology that saves energy and eliminates unnecessary and costly energy waste in the economy. Examples include daylighting and new lighting technologies; high-performance building design; efficient heating and cooling equipment; and efficient motors, windows, appliances, and insulation. Every new construction project or retrofit has the potential to increase efficiency over standard practices. Most energy efficiency projects have a significant return on investment (ROI). Immediate energy savings from efficiency improvements quickly translate into economic savings and benefits, helping residents and businesses offset the initial investments within a relatively short time frame. Additionally, financial savings from energy efficiency are often reinvested into the local economy, which leads to more job creation and economic growth.

Energy efficiency is increasingly becoming a high priority resource for Utah, yet we have only just begun to harness the enormous potential for energy savings. If Utah were

to achieve a 20% increase in energy efficiency in the electricity sector by 2015, annual electricity savings for Utahns would increase to over 6,800 Gigawatt hours (GWh) in 2015 - this is equivalent to the electricity needed to power over 750,000 Utah homes annually.²⁸ This study captures even more energy savings by modeling the energy efficiency policies and programs out to the year 2020. The 20% Clean Energy Scenario described in this analysis assumes the state implements the following types of initiatives to achieve Utah’s energy efficiency goal.

Natural Gas and Electric Utility Demand Side Management (DSM) programs

Utility demand side management (DSM) programs, such as those offered by Rocky Mountain Power and Questar Gas, provide incentives to offset some of the up-front costs of energy efficiency, and are essential to increasing energy efficiency in Utah. Utah’s utilities have made tremendous progress on this front, and they will continue to be instrumental partners in this effort. This study models an approximate doubling of the natural gas DSM programs (primarily in the industrial sector) and a roughly 40% increase in electricity DSM programs (over the Reference Scenario, as described on page 17.)

Building Codes and Building Efficiency

Given that buildings account for nearly half of all the energy consumed in the nation,²⁹ improving building efficiency is a critical component of achieving our energy efficiency goal. For example, new ENERGY STAR® homes typically use 20 to 30% less energy than standard homes.³⁰ These homes are also more comfortable due to properly sized and installed heating and cooling systems, efficient windows, and proper insulation. Increased building efficiency is contingent upon the state’s adoption and enforcement of the latest energy code. This study models the energy efficiency improvements associated with increased code training and education programs, and significantly enhanced enforcement of building energy codes.³¹

Lighting Efficiency Standards

Lighting efficiency is the “low hanging fruit” of cost-effective energy efficiency opportunities in nearly every building. In 2007, the federal government adopted a new lighting standard to dramatically increase lighting efficiency across the country by phasing out conventional incandescent lamps starting in 2012. This study takes into account the energy savings associated with the adoption of these national lighting standards. (It is worth noting that states always have the option to adopt increased efficiency standards on other products and appliances not covered by national standards, and this could be another means to increase in-state energy efficiency.)

Industrial Energy Efficiency

Utah’s industrial sector represents opportunities for significant energy savings through a combination of technical and financial programs, federal programs and incentives, voluntary energy efficiency targets, and utility DSM programs. This study models the increased efficiency associated with significant industrial energy efficiency improvements.

What is Demand Side Management?

Demand Side Management (DSM) entails cost-effective utility policies, programs, incentives and measures designed to encourage reduced energy use and demand by residential, commercial and industrial customers. DSM reduces energy consumption while preserving the same level of quality, service and comfort for energy customers; this reduces the potential for utility rate increases and conserves finite resources.

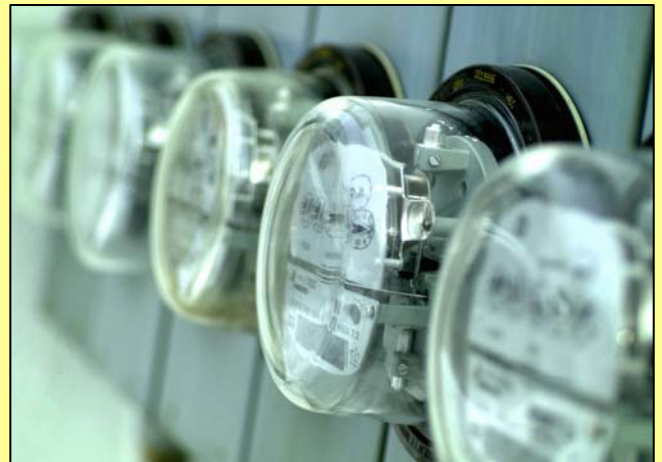
In Utah, Rocky Mountain Power and Questar Gas offer comprehensive DSM programs that are continuing to grow and receive significant support from utilities and utility customers.

Natural Gas DSM

Questar Gas, which serves approximately 98% of Utah’s residential and commercial natural gas load is expected to exceed their 2009 projected DSM spending. Questar spent \$18 million on DSM programs in 2008 and helped customers reduce their natural gas use by 4.3million therms per year as a result of programs implemented in 2008.

Electricity DSM

Rocky Mountain Power, a subsidiary of PacifiCorp serves approximately 80% of Utah’s electricity load and spent approximately 2.6% of their revenues, \$36.4 million, on energy efficiency programs in 2008, up from \$28.5 million in 2007. RMP helped its customers reduce their electricity use by 193 million kWh per year as a result of DSM programs implemented in 2008. RMP is also significantly expanding its DSM programs in 2009.



Energy Efficiency on the Farm: Dairy Pump Retrofits

Today's dairy farms provide a good opportunity for energy and cost savings through energy efficiency upgrades. Twenty three different dairies in Oregon and Washington participated in a utility sponsored energy efficiency incentive program called Energy FinAnswer. The result is a proven track record for saving energy and costs by reducing energy consumption associated with vacuum pumps used for milking. For these dairies, electricity costs were dramatically reduced by an average of 71 percent, or \$0.16 per pound of milk, by installing variable frequency drive (VFD) controls on the milk extraction vacuum pumps.



Through the FinAnswer program, offered by Rocky Mountain Power (and its sister company in the Northwest), the dairies received a vendor-neutral, investment grade analysis and cash incentives for the pump upgrades. The incentives paid to the dairies accelerated the average payback time from 4.5 to 2.3 years.

The equipment refinements were completed without interrupting production, and in addition to energy cost savings, the program improved dairy operations and extended equipment life.

Quick Facts

Project: Dairy vacuum pump efficiency upgrades

Companies involved: 23 dairies and Rocky Mountain Power/PacifiCorp

Location: Oregon and Washington (PacifiCorp service territory)

Resource technology: Installation of energy efficient variable frequency drive (VFD) controls on dairy pumps

Implementation costs: \$11,568

Annual electricity cost savings: \$2,569

Incentives paid: \$5,580

Incentive as % of implementation cost: 48%

Simple payback before incentives: 4.5 yrs (based on \$0.03/kwh)

Simple payback after incentives: 2.3 yrs (based on \$0.03/kwh)

Source: Rocky Mountain Power/PacifiCorp, 2006

Energy Efficiency Retrofit and Cost Savings at Ogden Manufacturing Plant

In 2008, ETC Group, LLC, a Utah-based energy engineering firm, completed an energy efficiency retrofit for an Ogden-based manufacturer of high precision machine parts. Their operation required a cooling system to operate 24 hours a day. The expense to power the existing cooling system was considerable so when the manufacturer identified a need for additional production equipment and increased cooling, they consulted ETC Group, LLC to upgrade the system and improve efficiency.

The existing cooling system was replaced with one that reduced power consumption by 48 percent, saving the company approximately \$116,000 in energy costs every year. In addition, the new system has the capacity to accommodate future growth and will likely extend the life of the manufacturer's equipment. This project utilized DSM incentives from Rocky Mountain Power, improving the payback of the up-front investment.

Quick Facts:

Jobs: Approximately 10 engineers, contractors and utility representatives worked for 6,813 "person-hours" on this project.

Project: Cooling system upgrade at manufacturing facility

Company: ETC Group, LLC

Location: Ogden, Utah

Total project cost: \$1,340,000

(before incentives of approximately \$250,000)

Annual energy savings: 2,028,000 kWh

Annual cost savings: \$116,000

Simple payback: 9 years

Source: Phone interview with Mark Case and Chris Benson, ETC Group, LLC on Feb 17, 2009.



*High efficiency cooling towers at Ogden manufacturing plant
(credit: ETC Group, LLC)*

Renewable Energy - Inexhaustible and Homegrown

Renewable energy resources complement and help diversify Utah's existing electricity resources while creating new opportunities for jobs and economic development, especially in Utah's rural communities.

In 2008, the state of Utah initiated the Utah Renewable Energy Zone (UREZ) Task Force to identify Utah's homegrown renewable energy resources (wind, concentrating solar, and geothermal) suitable for utility-scale electricity generation. Phase I of the UREZ report demonstrates that Utah has enormous technical renewable energy potential to contribute substantially to our growing energy needs.³²

The new renewable energy resources modeled in the 20% Clean Energy Scenario represent a small fraction of Utah's technical renewable energy potential, suggesting the capacities modeled are conservative and achievable. Renewable resources modeled include:

- 475 MW of wind generation in Utah (and 475 MW of out-of-state wind generation which does not contribute to Utah economic development in this study);
- 241 MW of geothermal generation;
- 150 MW of concentrating solar power (CSP) with storage;
- 84 MW of residential and commercial solar photovoltaic (PV) distributed electricity; and
- 23 MW of various types of biomass.

The renewable electricity generated from this mix of renewable energy resources expands Utah's percentage of renewable electricity usage from roughly 4% in 2007 to 20% by 2020. A detailed description of the 20% Clean Energy Scenario development methodology can be found in Appendix D.

Utah's Wind Potential

Utah experienced a historic year for wind in 2008, developing its first commercial wind project in Spanish Fork and the First Wind Milford Wind Corridor Project breaking ground in Beaver and Millard Counties. Both projects generated meaningful revenue and jobs, demonstrating that wind can be an important economic driver in Utah, especially in Utah's rural communities. According to the UREZ Report, Utah has twelve wind sites with expected gross capacity factors of at least 30% (which is economically viable in the wind industry).³³ These sites account for 1,830 MW or greater generating capacity,³⁴ which would provide enough electricity for over 534,000 average Utah homes,³⁵ while also providing numerous additional benefits including: increased annual property tax revenues to counties and school districts; a "new cash crop" to farmers and ranchers in the form of annual land lease payments; and significant water savings over other electricity resources as wind electricity generation uses no water.³⁶ This study models the development of 475 MW of Utah wind, roughly one-quarter of Utah's highest quality technical wind potential.

Utah's Geothermal Potential

Geothermal energy is heat derived from the rock and fluid in the earth's crust. Geothermal electricity provides valuable base load energy (or continuous energy supply), and Utah is among the leading states in the nation for geothermal electricity development potential. Interest in Utah's geothermal potential has increased noticeably over the past couple of years, with new projects breaking ground in both Beaver and Box Elder counties, as well as a planned expansion of Utah's first geothermal power plant, Blundell, in Beaver County. According to the UREZ report, Utah's geothermal electricity technical potential is over 2,100 MW, which includes 754 MW from identified sites.³⁷ This study models the development of 241 MW of geothermal electricity by 2020 - roughly one-third of Utah's identified technical potential.

County officials expected the [Milford] wind farm would bring in \$1 million a year in taxes and other revenue. "This [project] is significant in the assessed value and the permanent jobs it would bring," Johnson said. "It means production of good, green, cheap power."

- Beaver County Commissioner Chad Johnson
(Salt Lake Tribune, October 2008)

Utah's Concentrating Solar Power (CSP) Potential

Concentrating solar power (CSP) is utility-scale solar technology that employs mirrors to reflect and concentrate sunlight onto receivers that collect the solar energy to produce steam, which is then used to rotate large turbines and produce electricity.³⁸ CSP technologies provide valuable power during peak energy demand periods, and when coupled with thermal storage, the generation capacity can be extended significantly.³⁹ With Utah's wide

open spaces and ample sunlight, Utah boasts significant CSP potential. When only the highest-quality sites are evaluated, our potential is approximately 11,800 MW, according to the UREZ report.⁴⁰

While the potential for CSP in Utah is enormous and CSP technology is increasingly becoming more cost-competitive, this report models a conservative 150 MW of CSP in Utah.

Rural Utah Celebrates the Wind

After years of complaining about the wind in Beaver and Millard Counties, local residents are finally celebrating the wind. Thanks to the tremendous wind resource in the area, these rural counties will be home to Utah's largest commercial wind project in 2009, which will bring new property tax revenues, economic opportunities and jobs.

In November 2008, the Milford Wind Corridor Project broke ground, just north of Milford, Utah. Developed by First Wind, an independent North American wind energy company, the first phase of the project will provide 203 Megawatts (MW) of wind capacity upon its completion. The project will cover 40 square miles and the power will serve about 39,000 homes in the Los Angeles area.

"First Wind is proud of its track record of developing projects, bringing local jobs and working with the communities. Here in Milford, we look forward to a continued community partnership as this project comes to fruition and brings a host of economic and environmental benefits to the region," said Paul Gaynor, CEO and President of First Wind.

Quick Facts:

Jobs: 225 Construction; 12-15 Operation & Maintenance (phase 1)

Project: Milford Wind Corridor Project

Company: First Wind

Location: Millard County and Beaver County, Utah

Equipment: 97 wind turbines (phase I)

Resource technology: Wind

Capacity: 203 Megawatts (MW, phase 1)

Power purchaser: City of Los Angeles



Wind turbine towers at the Milford Wind Project construction zone (credit: First Wind)

Source: First wind begins construction on Milford Wind Corridor Project. First Wind Press Release. November 11, 2008. URL: <http://www.milfordwind.com/milford/news.cfm?ID=04d85e42-f43d-487d-b330-c9203ea3f8c1>

Utah's Solar Photovoltaic (PV) Potential

Solar PV systems convert the sun's energy to provide electricity directly to homes and buildings (in the case of distributed generation) or directly to the grid, via utility-scale solar PV projects (not modeled in this study). Though solar PV systems can be placed on the ground, systems are typically installed on rooftops. Utah's technical potential for rooftop solar photovoltaic (PV) in 2010 is 5,000 MW,⁴¹ which could produce enough solar electricity to power 778,000 Utah homes for a year.⁴² Solar PV electricity provides valuable summer peak power and helps mitigate the risk of volatile fuel costs and future carbon regulation. Utah has approximately 1 MW of distributed solar PV capacity installed across the state, and there are over 40 active solar businesses in Utah. This study models 84 MW of solar PV installed by 2020.

Utah's Biomass Potential

Biomass electricity is generated from plant and animal residues and landfill gases through the process of direct firing, co-firing, gasification, pyrolysis, and/or anaerobic

digestion (bio-digesters).⁴³ Currently, there are two land-fill-to-energy projects in Utah with a combined capacity of 4.8 MW and a few anaerobic digestion demonstration projects at farm, ranch, and dairy operations across the state.^{44,45} Estimates indicate Utah has the technical potential for 140 MW of biomass.⁴⁶ This study models the development of 23 MW of biomass electricity in Utah by 2020.

As described above, Utah's vast technical potential for energy efficiency and renewable energy development goes well-beyond the amounts modeled in the 20% Clean Energy Scenario. The 20% Clean Energy Scenario could be implemented with today's commercially available technologies - no technological breakthroughs are assumed. It is also worth noting that construction time for energy efficiency and renewable energy technologies is relatively fast, allowing for a rapid deployment of these technologies in the near term, and vast renewable energy deployment upon development of new transmission infrastructure.

Concentrating Solar Power Shines in Nevada's Desert

Generating enough electricity to power more than 14,000 Nevada households annually, Acciona's Nevada Solar One™ is leading the way for concentrating solar power and demonstrating the viability of utility-scale solar power. Solar One is the third largest concentrated solar power plant in the world and the largest concentrating solar power plant to be built in the U.S. in the last 17 years.

Based in Boulder City, Nevada, Solar One has been in operation since June 2007. The power plant has nominal production capacity of 64 megawatts (MW) and a maximum capacity of 75 megawatts (MW).

Quick Facts:

Jobs: Approximately 28 operation & maintenance

Company: Acciona

Location: Boulder City, Nevada

Project name: Solar One

Total investment: \$266 million

Resource technology: Concentrating Solar Power

Construction period: 16 months

Power purchaser: Nevada Power Company and Sierra Pacific Power Company



Nevada Solar One depiction (credit: Nevadasolarone.net)

Methodology

Scenarios Modeled and Evaluated and Assumptions

This analysis evaluated the net economic and employment impacts to the State of Utah of two distinct energy portfolio scenarios in the year 2020 – Reference Scenario and 20% Clean Energy Scenario, described below – using the following economic indicators:

- Total and net contribution to employment (one job is defined as sufficient wages to employ one person full-time for one year);
- Total and net change in earnings; and
- Total and net contribution to Gross Domestic Product by State (the value of final goods and services produced by the labor and property located in a state; it is the state counterpart to the national Gross Domestic Product).

This analysis is likely conservative because it assumes that the production and use of renewable energy and increased energy efficiency addresses only the demand within the state's borders and does not model the economic benefits if Utah becomes a leader and exporter of products, goods, and services related to emerging clean energy industries.

The two 2020 energy portfolio scenarios and assumptions are as follows:⁴⁷

- **Reference Scenario:** This scenario reflects the 2007 utility resource planning documents.⁴⁸ It is based closely on PacifiCorp's 2007 resource planning documents and treats the entire state of Utah as if it followed PacifiCorp's electricity plan through the year 2020.⁴⁹ By 2020, this scenario develops new natural gas plants, 9% renewable energy (mostly out of state wind) and a modest amount of energy efficiency through utility demand side management programs (DSM) (see Figure 3). This scenario also assumes a continuation of Questar Gas's energy efficiency programs at 2007 funding levels. Since the 2007 IRP details resources out to 2017, the years 2018-2020 were inferred from previous years' developments, and continues a 2.7% annual sales growth rate (see Figure 4).

- **20% Clean Energy Scenario:** This scenario represents significantly more renewable energy and energy efficiency measures than the Reference Scenario. In this model, renewable energy represents 20 percent of Utah electricity sales in 2020 and energy efficiency is increased statewide 20 percent by 2015. Those energy efficiency investments are extended to the year 2020. The target date for the renewable energy goal was accelerated by five years to 2020 to more closely coincide with the available quantified energy efficiency data⁵⁰ and the projected sales growth and capacity requirement data from PacifiCorp's 2007 Integrated Resource Plan ("IRP") and 2007 IRP Update.^{51,52} Only a portion of the energy efficiency measures in this scenario come from utility DSM Programs; the additional energy efficiency improvements come from other measures, as identified on pages 10-13 of this report. For additional data regarding the energy efficiency modeling assumptions see Online Appendix *Energy Efficiency for Electricity and Natural Gas Sectors*, in particular Spreadsheet 7 "EE Inputs" as well as Spreadsheets 8-16.

Electricity savings are approximately three times higher than in the Reference Scenario, and the natural gas savings are approximately six times higher. The energy efficiency and renewable energy resources in this portfolio replace the planned combined cycle natural gas plants and peak-hour purchases in the Reference Scenario, and additional simple cycle natural gas resources are included to meet peak demand and to balance new renewable resources (see Figure 3). Over 90% of existing electricity resources will be necessary to meet the electricity sales in 2020 (See Figure 4). This scenario also assumes no change in demand for coal mining and natural gas drilling as compared to the Reference Scenario since existing coal generation remains online and regional demand for natural gas will likely offset any decrease in Utah demand.

Accounting for planned closures of existing facilities and 12% planning reserves, Utah will require 2,947 MW of new resources available at peak demand (typically late afternoon in the summer) by 2020. Both scenarios develop the same amount of peak capacity by 2020,⁵³

and were designed to meet peak capacity needs by 2020, not just energy needs. It was assumed that PacifiCorp had excess energy from their existing resources in 2006, some of which was used to meet Utah sales demand for the Reference Scenario. Both scenarios still had excess energy in 2020. The principal difference between the two scenarios is the amount of energy efficiency and renewable energy resources developed by 2020, which replace new combined cycle natural gas plants and Front Office Transactions (purchases), see Table 1 on following page.

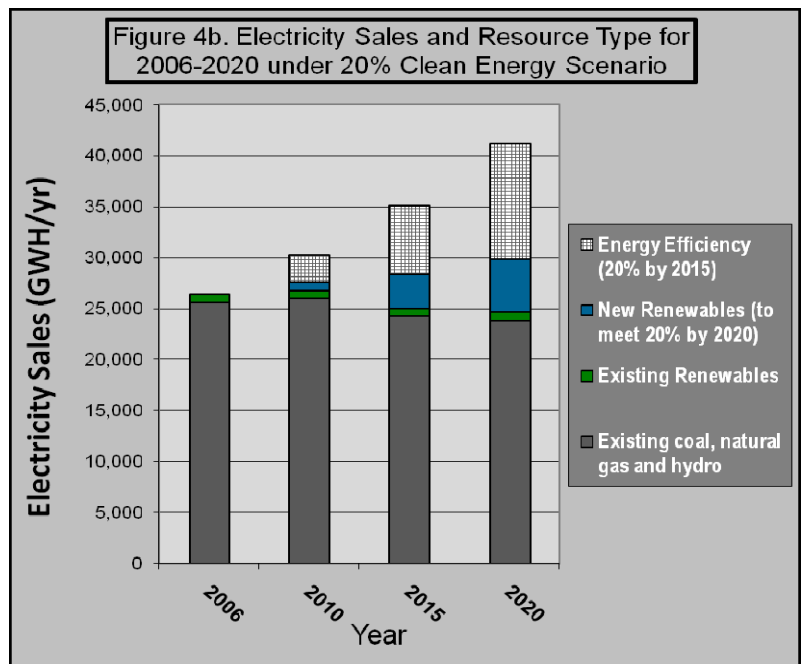
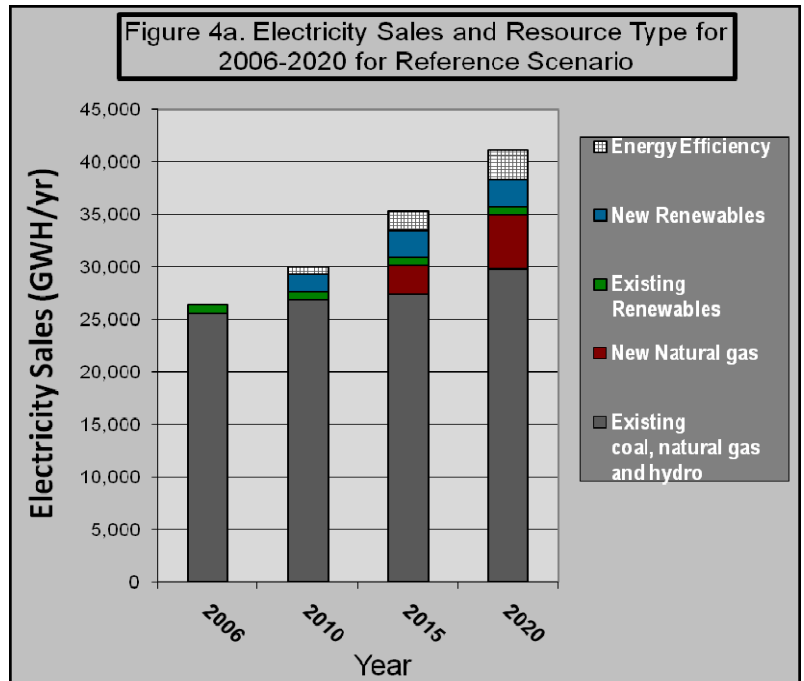
Investments

The 20% Clean Energy Scenario will require an estimated investment of \$8.9 billion over the 14-year period analyzed in this study (2007 – 2020), or \$500 million more than the Reference Scenario.⁵⁴

The Reference Scenario will require an estimated investment of \$8.4 billion over the 14-year period, with 33 percent invested in ongoing fuel costs and an additional 2% on front office transactions (or purchases; year 2020 only; see Figure 5). Since the Reference Scenario was based on a regional planning document, to make a direct comparison between the two scenarios, the amounts quoted here are Utah’s share of the cost of the investments for both scenarios. The 20% Clean Energy Scenario invests approximately 93 % of total investments in up-front capital investments (i.e., new installations of renewable energy systems, retrofitting existing buildings, making new construction more energy efficient, etc.) with only 1% designated for ongoing fuel costs (see Figure 6). Both scenarios invest approximately 6-7 % of total costs on operations and maintenance.

Energy efficiency and renewable energy are fossil-fuel-free resources that will provide energy savings and clean energy well beyond the 2020 horizon, but the benefits of these energy savings after 2020 are not included in this analysis. The energy savings in dollars modeled in this analysis are included in Table B5 of Appendix B.

The amount of fuel presented in Figures 5 and 6 are for the new resources only and do not account for ongoing fuel costs for the existing resources (which would be nearly the same for both scenarios). For a breakdown of the investments by resource type for each scenario, please see tables B3, B4 and B5 of Appendix B.



Future economic analyses could evaluate the costs and risks associated with different investment strategies (i.e. spending more up-front capital on renewable and energy-efficient resources that do not have ongoing fuel costs versus spending up-front capital on fossil fuel resources that require ongoing fuel investments and are accompanied by the risks associated with fuel volatility and the cost of carbon emissions).

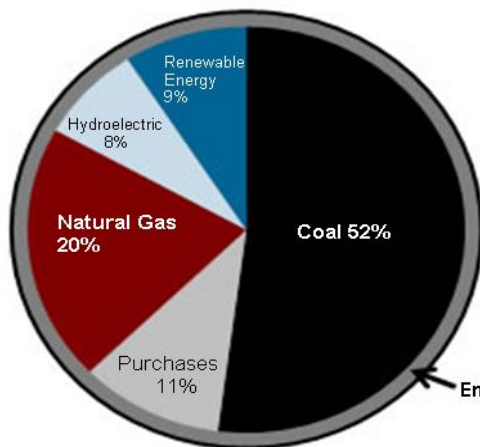
Table 1: New Electricity Resource Capacity Developed Under Each Scenario (2007-2020)

	Reference Scenario (MW)	20% Clean Energy Scenario (MW)	
Resource Type	Total New Resources (MW)	Total New Resources (MW)	Net Difference from Reference Scenario (MW)
Supply Side Resources			
Utah Wind	21	475	454
Out of State Wind (Utah's share)	736	475	-261
Utah Solar PV	2	84	82
Utah Solar CSP	0	150	150
Utah Geothermal	51	241	190
Utah Biomass	4	23	19
Utah Simple Cycle Capacity	0	79	79
Utah Combined Cycle Capacity	1,220	0	-1,220
Out of State Combined Cycle Capacity (Utah's share)	529	0	-529
Out of State Year 2020 Front Office Transactions (Utah's share, not cumulative)	1,004	0	-1,004
Total	3,567	1,527	-2,040
Energy Efficiency Resources			
Utah Energy Efficiency (aMW)	329	1,296	967

Note: The Utah capacities presented here are what were developed in Utah for each scenario to capture their full economic development potential in this study, and in the case of the Reference Scenario, before Utah's share of the capacity is taken into account. Out of state resources are not modeled in this study. For energy efficiency, average megawatts (aMW) are used. The aMW are calculated by dividing the MWh saved from energy efficiency measures by the number of hours in the year.

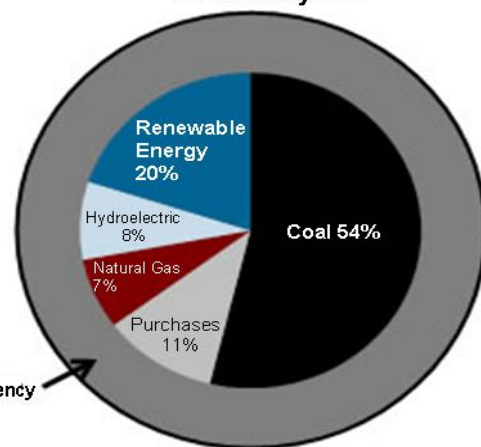
Figure 3. Electricity Mix for Each Scenario

Reference Scenario Electricity Mix



Supply-side Electricity: 38,285 GWh
 Energy Efficiency: 2,886 GWh
 Total Electricity: 41,171 GWh

20% Clean Energy Mix Scenario Electricity Mix



Supply-side Electricity: 29,817 GWh
 Energy Efficiency: 11,354 GWh
 Total Electricity: 41,171 GWh

Key: Black circle: Total energy needed by 2020 (41,171 GWh); pie chart: supply-side resources and percentages; gray ring: energy efficiency. All areas drawn to scale.

Job Creation Compared to GOPB Baseline

The job creation resulting from the model scenarios are compared to a baseline scenario (GOPB Baseline), which is the anticipated employment by sector in 2020, as projected by the Governor's Office of Planning and Budget (GOPB). The GOPB Baseline reflects anticipated changes in the structure of Utah's economy over time (see Table 2). Total employment for Utah is projected to increase by about 446,300 jobs by 2020, according to the GOPB Baseline.

The Governor's Office of Planning and Budget projects that three of Utah's traditional energy sectors (oil & gas mining, coal mining, and oil refining) combined will experience a loss of approximately 1,000 jobs, reflecting current trends in the Utah economy outside of the electricity and natural gas utility resource plans.

The job figures reported in this study reflect both the gains and losses relative to the GOPB Baseline projections in the year 2020. For example, the GOPB Baseline projects that the construction sector will gain 22,117 jobs by 2020 (see Table 2). So, the net gain of 2,450 jobs projected for the construction sector under the 20% Clean Energy Scenario means that instead of gaining 22,117 jobs, the construction-sector would gain 24,567 jobs in 2020 (see Table 4 on page 25).

For this analysis, a job is defined as sufficient wages to employ one person full-time for one year.

Industry	2007	2020	Change 2007 to 2020
Agriculture	27,538	29,580	2,042
Oil and Gas Mining	2,020	1,375	-645
Coal Mining	1,690	1,354	-336
Construction	71,387	93,504	22,117
Food	121,393	151,615	30,222
Manufacturing	118,663	139,623	20,960
Oil Refining	1,069	1,028	-41
Other Mining	3,864	4,137	273
Motor Vehicles	40,364	52,396	12,032
Wholesale Trade	56,580	69,887	13,307
Transportation and Communication	59,399	74,086	14,687
Services	383,541	536,525	152,984
Government	219,422	278,904	59,482
Retail Trade	89,243	112,453	23,210
Finance	40,448	50,190	9,742
Insurance/Real Estate	27,935	35,756	7,821
Utilities	6,673	7,413	740
Total	1,271,229	1,639,826	368,597

Solar Panel Production Facility Brings Big Investments and Hundreds of Jobs

Signet Solar Inc. is expanding the company's first North American solar panel production facility in Belen, New Mexico. The 150,000 square foot facility will expand to 600,000 square feet by 2012. The Signet facility will produce large area thin-film silicon photovoltaic modules. The first phase of the plant will have an annual production capacity of 65MW – enough to power approximately 20,000 homes. In 2012 production capacity is expected to increase to 300 MW per year.

Quick Facts:

- Jobs created:** 600 high-wage jobs
- Company:** New Mexico Partnership
- Location:** Belen, New Mexico
- Project name:** Signet Solar
- Total investment:** \$840 million
- Resource technology:** Solar panel production

Source: URL: <http://www.signetsolar.com/>



Utah's Economy in 2020

This study is a macroeconomic analysis of Utah's economy in the year 2020 under different electricity scenarios (described above). The analysis models inputs from a single year of investment (2020) which, under the 20% Clean Energy Scenario, is the year when renewable energy represents 20 percent of all electricity sales and the 20 percent energy efficiency goal has been achieved (with an additional five years of energy efficiency investments).

The analysis captures the following effects on Utah's economy:

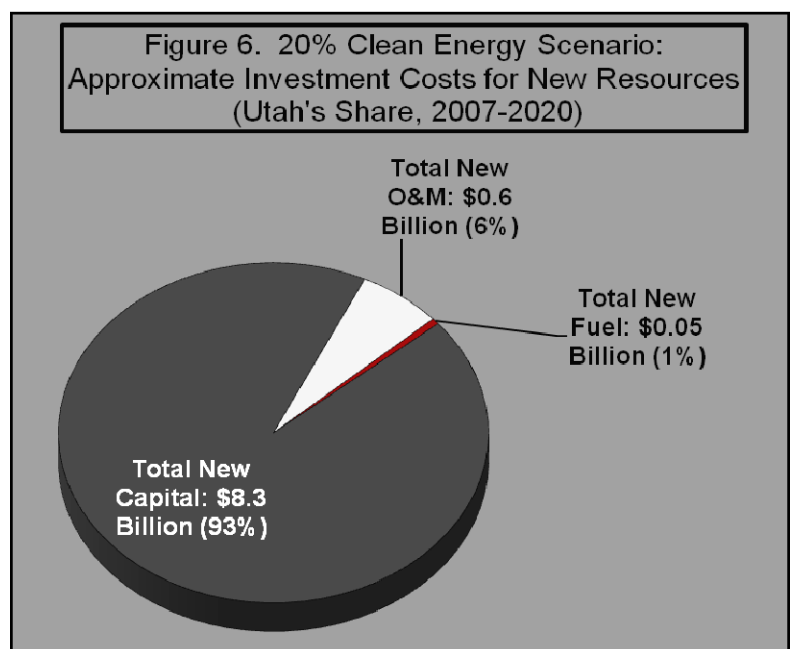
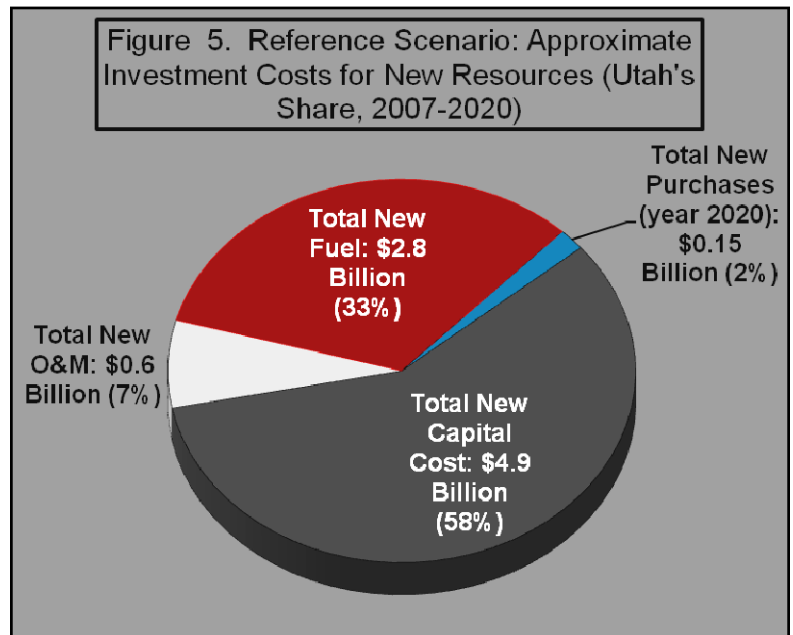
- Construction-related impacts associated with developing projects in the year 2020;
- Ongoing operation and maintenance of projects installed from 2007-2020;
- Energy savings from previous (installed before 2007) and new (installed after 2007) energy efficiency measures from 2007-2020;
- Investments from the cumulative installation of energy efficiency measures;
- Operation and maintenance jobs, earnings and GDPs impacts of renewable and natural gas investments from 2007-2020.

In order to avoid an artificial impact to the analysis arising from a specific resource coming online in 2020 (or any particular year) under each scenario, this analysis employs a multi-year (or average annual) phase-in of the investment costs related to construction of new projects. This approach ensures the results do not double-count construction related jobs from the earlier years and more accurately reflects employment activity in the Utah economy in the year 2020. In addition, the construction jobs modeled this way better capture the steady development of new renewable energy and energy efficiency installations.

This study evaluates the impacts to all state industries, and any potential job losses or shifts in eco-

nomics activity from traditional resource sectors (e.g., coal and natural gas) are accounted for in the net numbers for jobs and economic development.

This study assumes continued demand for coal and natural gas given no significant decreases in existing electricity resources, anticipated increases in regional demand for natural gas, and new export potential via new pipelines.⁵⁵



The Input-Output Modeling Process

The input-output modeling performed in this analysis is based on multipliers derived from the IMPLAN (IMPact analysis for PLANning) Model, and captures economic activities as a ratio of the total change in economic activity in the region relative to the direct final demand changes in one or more sectors. This input-output model estimates job growth, earnings and gross domestic product by state (GDPS) that may result from new investments in energy efficiency measures and renewable energy resources. Generally speaking, input-output models recognize the complexity and interrelatedness of state and regional economies, and incorporate existing relationships between industry sectors and spending patterns to estimate the impact of demand changes (e.g., increased investment) in a region in a particular industry sector. The IMPLAN multipliers capture inter-industry linkages (i.e.,

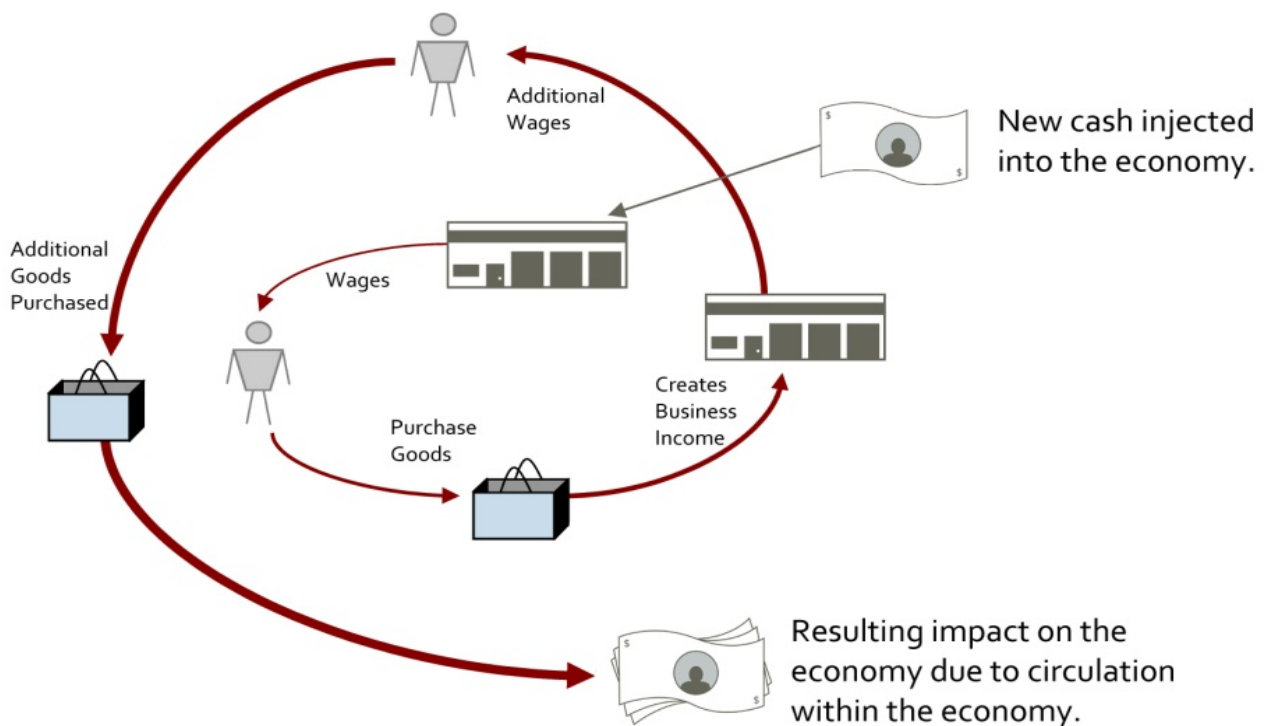
what each business or sector purchases from other industry sectors) to produce goods or services (the GDPS).

There are three basic categories of in-state spending captured in the modeling:

- Direct: The on-site or immediate effects created by an expenditure;
- Indirect: The increase in economic activity that occurs when a contractor, vendor or manufacturer receives payment for goods or services and in-turn pays others who support their business;
- Induced: The change in household spending (from earnings) resulting from the direct and indirect demand changes (associated with the investments in the economy).

The Multiplier Effect in an Input-Output Model

Figure 7



Note: In addition to wages spiraling outward through the economy, each industry has to pay its suppliers. Each supplier then reinvests their money into wages and their own supplies, furthering the amount of money circulating in the economy. The combined flows generated by the initial investment through both the wages paid and the suppliers' revenue creates the total the multiplier effect.

This is sometimes referred to as the multiplier effect. For example, assume a homeowner or business decides to purchase new energy-efficient windows to replace their old leaky windows. In this instance there is an increase in demand for new energy-efficient windows; assume for the purposes of the example it's \$100. The window manufacturer receives the \$100 and in turn, pays a portion of that \$100 to the aluminum provider for the frame materials, the glass provider for the glass, and to its own employees (direct spending) for the labor to assemble the windows. Each of the businesses receiving a portion of the \$100 then pays its own employees and suppliers of goods and services (indirect spending). Additionally, the employees of all these businesses spend their earnings in the economy, further increasing the impact of the initial investment for new windows (induced spending). By the time the \$100 has circulated through the economy, it represents a significantly greater economic benefit than the initial increase in demand (see Figure 7). The impact of increased investment is measured in employment, earnings, and overall contribution to the GDPs.

In the context of energy-efficiency investments, businesses and households are able to meet their energy, heating, cooling, and lighting needs at a lower cost due to those investments. This lower cost of doing business and operating households makes more money available for businesses and families to spend or invest in the state economy.

Role of Multipliers

Each industry has a set of ratios, known as “multipliers,” for employment, earnings, and economic output. Employment multipliers show the number of jobs that are directly and indirectly supported for each \$1 million of demand in a specific industrial sector. Therefore, depending upon the structure of the local economy, certain sectors of the economy create more economic impact than others. For example, the state employment multiplier for the construction industry is more than ten times that for the electric utility industry, the earnings multiplier is about five times higher, and the output multiplier is slightly lower.⁵⁶

This analysis includes the following assumptions for expenditures and multipliers:

- Not all of the expenditures benefit the state's economy;
 - Approximately 35 percent of the total power plant and renewable expenditures, including both the construction phase and the operations phase expenditures, will be spent within the state of Utah;
 - Only 90 percent of the efficiency investments are spent within the state of Utah;

Employment impacts account for future changes in labor productivity in specific sectors based on an analysis of productivity trends;⁵⁷

- Investments in the energy efficiency and renewable technologies will be financed;⁵⁸
- All renewable energy facilities are operated by electric utilities; and
- In-state manufacturing (modeled in the sensitivity analysis described on page 28) reflects the distribution by state of industries that currently manufacture renewable components or have the capability to do so in the near future.

It is worth noting that the availability of local resources, including labor and materials and locally manufactured power plant components, can have a significant effect on the costs and the economic benefits that accrue to the state or local region.

For further details on the methodology employed in this report, please see Appendix D at the end of this report, as well as the complete Appendix available online at http://utahcleanenergy.org/utah_economic_development_study/appendix.

Results: CLEAN ENERGY CREATES JOBS AND STIMULATES NEW ECONOMIC DEVELOPMENT

According to this analysis, the 20% Clean Energy Scenario provides a net increase in jobs, earnings, and GDPS over the Reference Scenario, stimulating new economic development for Utah (see Table 3).

Jobs

This analysis finds that the 20% Clean Energy Scenario will create nearly 7,000 more ongoing jobs than the GOPB Baseline by 2020. The net increase above the Reference Scenario is over 4,000 jobs (the Reference Scenario will create approximately 2,800 jobs). The construction sector and the services sector (education, health care, professional services, hospitality, etc.) represent the majority of jobs in both scenarios (see Table 3).

Job impacts in Table 3 show the changes in employment by sector by 2020 under the GOPB Baseline, and the net changes to that Baseline under the Reference and 20% Clean Energy Scenario. It is important to note that the net changes by sector for both scenarios reflect impacts to the *projected 2020 jobs*, not impacts to *existing* (year 2007) jobs.

Overall, the implementation of the energy efficiency measures and the resulting energy savings spent in the local economy create a vast majority of the jobs in the 20% Clean Energy Scenario. The unique combination of the direct and indirect impacts of building and purchasing

products to improve the energy efficiency infrastructure, combined with the induced impacts of this spending and the spending of energy bill savings makes energy efficiency a particularly attractive resource in terms of job creation.

The job creation from the new renewable energy facilities is comparable to the number of net jobs created from new natural gas plants and increased drilling.

Compared to the Reference Scenario, the 20% Clean Energy Scenario shows an increase in the projected number of jobs in the following sectors: Agriculture & Food (130), Wholesale and Retail Trade (860), Manufacturing (210), Government (410), Finance (180), and Insurance/Real Estate (160). The 20% Clean Energy Scenario decreases the number of projected jobs created for the Transportation & Communication (-140) and Utility [electric and natural gas (-690)] sectors as compared to the Reference Scenario (see Table 4).

Since the oil, gas and coal sectors were assumed to remain constant in this analysis, both scenarios reflect the same changes to these jobs, with 430 new net oil & gas mining jobs (15 percent of the total jobs) and a net loss of 20 coal mining jobs (a slight decrease from the GOPB Baseline projections). A detailed description of the sensitivity analysis around this assumption follows.

The results presented here are an analysis of Utah's economy in the year 2020 and represent the ongoing jobs, annual earnings and annual GDPS in 2020 resulting from each scenario.

**Table 3. Jobs and Economic Development by 2020:
Reference Scenario Compared to 20% Clean Energy Scenario**

	Jobs		Earnings (\$Millions)		GDPS (\$Millions)	
	Net Total over GOPB Baseline	Net over Reference Scenario	Net Total	Net over Reference Scenario	Net Total	Net over Reference Scenario
Reference Scenario	2,800	N/A	\$160	N/A	\$280	N/A
...Natural Gas Plants/Drilling	1,710	N/A	\$130	N/A	\$300	N/A
...Renewable Energy	130	N/A	\$10	N/A	\$10	N/A
...Energy Efficiency	960	N/A	\$20	N/A	-\$30	N/A
20% Clean Energy Scenario	6,890	4,100	\$310	\$140	\$300	\$20
...Natural Gas Plants/Drilling	1,100	-610	\$100	-\$30	\$260	-\$40
...Renewable Energy	1,040	910	\$60	\$50	\$70	\$60
...Energy Efficiency	4,750	3,800	\$150	\$130	-\$30	\$0

Note: All dollar amounts are 2008\$. Assumes no additional change in demand for coal mining and natural gas drilling for 20% Clean Energy Scenario as compared to Reference Scenario.

Earnings

The 20% Clean Energy Scenario provides earnings of \$310 million in 2020, while the Reference Scenario provides earnings of \$160 million, yielding a net increase of \$140 million (see Table 3).

In Table 3, the total net earnings associated with the energy efficiency sector in the 20% Clean Energy Scenario relative to the number of jobs created appears low. However, it is important to note that one cannot simply divide the total net earnings by the number of jobs to arrive at an average wage for the 20% Clean Energy Scenario because this number reflects a *net* change in earnings. The average annual salary of the created jobs is roughly \$58,000. Accounting for the number of jobs created per

sector within the energy efficiency and renewable energy economies, the weighted average annual salary of the jobs created through the energy efficiency investments is \$52,000 and \$51,000 for the renewable energy investments.⁵⁹

Gross Domestic Product by State (GDPS)

In the 20% Clean Energy Scenario, Utah's GDPS is estimated to increase by about \$300 million in 2020. This compares with the Utah ski industry, which contributed about \$440 million to GDPS in 2008,⁶⁰ suggesting that growing the renewable energy and energy efficiency sectors can play a substantial role in Utah's economy in the near future.

Table 4. Comparison of Net Job Impact by Sector for Reference and 20% Clean Energy Scenario

GOPB Job Projections		Ongoing Jobs Impact by 2020 compared to GOPB			
Industry	GOPB Projected Change 2007 to 2020	Reference Scenario Net	Reference Scenario Total	20% Clean Energy Scenario Net	20% Clean Energy Scenario Total
Agriculture	2,042	20	2,062	110	2,152
Oil and Gas Mining	-645	430	-215	430	-215
Coal Mining	-336	-20	-356	-20	-356
Construction	22,117	890	23,007	2,450	24,567
Food	30,222	10	30,232	50	30,272
Manufacturing	20,960	40	21,000	230	21,190
Oil Refining	-41	0	-41	0	-41
Other Mining	273	20	293	30	303
Motor Vehicles	12,032	0	12,032	0	12,032
Wholesale Trade	13,307	50	13,357	150	13,457
Transportation and Communication	14,687	-10	14,677	-140	14,547
Services	152,984	860	153,844	2,340	155,324
Government	59,482	60	59,542	470	59,952
Retail Trade	23,210	210	23,420	970	24,180
Finance	9,742	100	9,842	280	10,022
Insurance/Real Estate	7,821	90	7,911	250	8,071
Utilities	740	40	780	-690	50
Total	368,597	2,800	371,397	6,890	375,487

Note: Job impacts in Table 3 show the changes in employment by sector by 2020 under the GOPB Baseline, and the net changes to that Baseline under the Reference and 20% Clean Energy Scenario. It is important to note that the net changes by sector for both scenarios reflect impacts to the projected 2020 jobs, not impacts to existing (year 2007) jobs.

Clean Energy Manufacturing Sensitivity Analysis

In the Reference Scenario, the GDPS is expected to increase by \$280 million in 2020, essentially the same as the 20% Clean Energy Scenario.

The energy efficiency results for Reference Scenario show a small, but negative impact to the GDPS (as shown in Table 3). Interestingly, the substantially expanded (3-6 times more) energy efficiency measures in the 20% Clean Energy Scenario does not have a significant net impact to the GDPS as compared to the Reference Scenario.

The findings above reflect the assumption that none of the materials for the renewable energy developed are manufactured in-state (e.g., wind blades and solar panels). A sensitivity analysis was performed to determine the potential economic impacts of having Utah-based facilities manufacturing renewable energy components for use in-state, wherein a percentage of the total components needed for in-state renewable energy projects were manufactured in Utah: 50 percent of wind

Expanding Clean Energy Jobs through Workforce Development

Trained energy efficiency professionals are needed to help Utah achieve its goal to increase energy efficiency 20% by 2020. A skilled workforce will be required to perform energy audits, retrofit building and mechanical systems, and implement utility energy efficiency programs.

The Salt Lake Community College (SLCC) is working in partnership with energy efficiency experts, Rocky Mountain Power, Questar Gas, and Utah Clean Energy to design an **Energy Management Technician Program** to train and educate Utah's growing energy efficiency industry. The program, taught by local energy experts from related fields, will provide an Associates of Applied Science (AAS). Once the program reaches maturity, it is expected to graduate 25 students per year. Graduates are likely to find employment in a wide variety of disciplines, including: facility managers, energy auditors, utility program coordinators and project managers, and control system specialists. Employers include: engineering and energy consulting firms, energy service companies, city, county and state resource management groups, industrial facilities, light manufacturing, commercial real estate and multi location retail operations.

Quick Facts:

Partners Involved: Salt Lake Community College, Rocky Mountain Power, Questar Gas, Utah Clean Energy, energy efficiency industry experts

Location: Salt Lake City, Utah

Program Name: Energy Management Technician Program

Program Timeline: Graduates are expected to complete the program in 14-16 months.

Other Programs: This program will compliment SLCC's continuing education programs already offered: Intro and Advanced Solar Photovoltaic Design and Installation, Energy Manager Training, Compressed Natural Gas Conversion Training

Source: Based on communications with Lee Brinton, Salt Lake Community College January 7, 2009, and Don Jones, Jr, et al, Pacifi-Corp, January 13, 2009. All figures are based on projections and anecdotal evidence and prior performance of other programs.



Tour and technology overview of Orrin G. Hatch Geothermal plant (credit: Utah Clean Energy)

blades, 75 percent of wind towers, 50 percent of solar PV panels, and 0 percent of wind/gas turbines. The sensitivity analysis showed only a small increase of approximately 90 jobs (direct, indirect and induced), reflecting the relatively small level of spending on Utah manufactured renewable energy components in the sensitivity analysis.

However, if a renewable energy manufacturing plant were to locate in Utah or if existing plants were to retool, it would generate far more jobs than the in-state demand of renewable energy components modeled here. These manufacturing facilities could create a new export indus-

try for Utah's economy, while also supplying components to in-state renewable energy projects, helping to keep more money in Utah's economy.

Other states are starting to experience the economic effects of new renewable energy manufacturing facilities, such as the new Vestas facilities in Colorado.⁶¹ If Utah were to attract similar manufacturing facilities, our economy could reap added economic benefits of the jobs, beyond the 7,000 net new jobs created in the 20% Clean Energy Scenario.

Windfall of New Jobs for Colorado

Denmark-based Vestas is investing \$680 million in Colorado to build four wind turbine manufacturing plants, and big investments mean big jobs.¹

A blade factory in Windsor, Colorado is employing 464 people as of March 2008, and a new blade factory and a nacelle assembly factory in Brighton (15 miles outside of Denver) will bring 1350 additional jobs to the State.² The nacelle factory will be Vestas' first in the USA. By 2010, Vestas will employ 2,450 workers to produce wind turbine components at the new facilities.³



Vestas blade manufacturing facility (Credit: Vestas)

Colorado Governor Bill Ritter attributes Vestas' decision to locate manufacturing facilities in Colorado to easy access to rail and highways, a highly skilled work force, a supportive business climate, and to a strong dedication to growing Colorado's New Energy Economy from state and local leaders. Access to a large pool of qualified workers was another important factor selecting Brighton. The decision to establish manufacturing in Brighton follows a thorough placement analysis conducted in cooperation with the Office of Economic Development and International Trade, Metro Denver and Upstate Colorado.

Quick Facts:

Jobs created: 464 as of March 2008; 2,450 expected by 2010

Company: Vestas American Wind Technology, Inc.

Location: Colorado

Total investment: \$680 million

New manufacturing plants: 4

Equipment produced: 3,600 blades, 1,400 nacelles, and 900 towers per year

¹Vestas' wind-power plan more than bluster: Danish company will bring 2,450 jobs to Colo.. David Milstead. August 16th, 2008. <http://m.rockymountainnews.com/news/2008/aug/16/wind-power-plan-more-than-bluster/>

²Wind Turbine Maker Vestas To Add 1,350 Colo. Jobs. CBS 4 Denver. August 16, 2008. URL: <http://cbs4denver.com/seenon/vestas.colorado.wind.2.796234.html>

³ See note 1.

Gas Drilling and Coal Mining Sensitivity Analysis

A sensitivity analysis was performed around the assumption that there would be no additional impact to the natural gas drilling and coal mining sectors under the 20% Clean Energy Scenario as compared to the Reference Scenario. The sensitivity analysis showed significant impacts to the results if the decrease in Utah demand for natural gas was not met by regional export demand and coal use did not remain constant at our existing plants. The number of net jobs for the 20% Clean Energy Scenario would decrease by 1,700 jobs, resulting in 5,200 net ongoing jobs over the GOPB Baseline and 2,420 net ongoing jobs over the Reference Scenario (as opposed to 6,890 and 4,100 more net jobs, respectively, as reported above). The earnings for the 20% Clean Energy Scenario would decrease by \$150 million, resulting in net earnings that are \$160 million over the GOPB Baseline, and no net difference above the Reference Scenario (as opposed to \$310 million and \$140 million over, respectively). Finally,

GDPS would decrease by \$350 million, resulting in net GDPS of -\$50 million compared to the GOPB Baseline, and a net GDPS of -\$330 million compared to the Baseline Scenario (compared to \$300 million and \$20 million more, respectively).⁶²

The impact to the coal mining sector would be minimal since no coal plants were decommissioned in either scenario, and over 90% of existing resources are still required to meet the projected sales demand in 2020. The impact of that slight decrease in demand results in an additional loss of 70 projected jobs by 2020 compared to the GOPB baseline in the coal sector, and loss of \$10 million to earnings and \$20 million to GDPS.



Blundell employees give a tour of Blundell Geothermal Plant

Utah natural gas providers have good access to regional markets and demand for natural gas is rising, and will likely continue to do so until at least the year 2020 as more electric utilities look toward natural gas as a baseload and system balancing resource that has a lower carbon footprint than coal. Therefore, there is a strong case to be made that any decrease in Utah demand for natural gas would be off-set by regional demand.



Salt Lake Community College students help install solar panels at a low income house in Kearns, Utah as part of a PV Solar training course at the College.



Workers finalize the installation of the first wind turbine base at the Milford Wind Farm located in Milford, Utah.

Discussion

The Spectrum of Clean Energy Jobs

The jobs generated by these clean energy projects are varied and span the spectrum of new and existing professions – from researchers, architects, and high-tech engineers to technicians, building contractors, installers, and manufacturers. Traditional careers, such as accountants, attorneys, contractors, architects, electricians, plumbers, and construction managers also contribute significantly to these sectors, and the need for these professions will continue to grow to support the growing clean energy economy.⁶³ New clean energy training programs at high schools, applied technology colleges, community colleges, and universities will aid in preparing a robust, competitive workforce, representing additional opportunities to jumpstart and revitalize our economy and educational system. Pursuing the 20% Clean Energy Scenario generates more jobs than the Reference Scenario due to the labor- and material-intensive nature of widespread renewable energy and energy efficiency projects. In addition, as businesses, residents and communities as use energy more efficiently and reduce their energy consumption more money stays within the local economy, generating local jobs.

A New “Cash Crop”: Clean Energy for Rural Economic Development

The jobs and economic development resulting from the 20% Clean Energy Scenario would very likely provide a significant benefit to Utah’s rural communities, farms, and ranches due to the fact that Utah’s renewable energy resources are largely located throughout Utah’s rural communities. Landowners within these communities have the opportunity to tap into a new “cash crop” in the form of land-lease payments for wind turbines, while still keeping the majority of their land open for farming or grazing. Local governments, counties, and schools can benefit from property tax revenues paid by renewable energy developers. On a smaller scale, distributed renewable generation and energy efficiency can help farmers and ranchers save energy and money, thereby reducing operating costs. Furthermore, new developments offer the opportunity to employ local labor and generate new high-paying jobs. Similar opportunities extend to Utah’s Native American communities, which can benefit immensely from on-site renewable energy projects, distributed generation, and improved energy efficiency

measures. The promising geothermal project, Shoshone Renaissance, for the Northwestern Band of the Shoshone Tribe in Box Elder County, Utah, is an excellent example of great potential for renewable energy to generate new prosperity for Utah’s tribal communities.

Additionally, Utah’s rural agricultural communities present a great opportunity to save energy and keep dollars in the local economy by increasing energy conservation and energy efficiency. Agricultural operations not only benefit from renewable energy developments, but they are also poised to reap significant benefits from increased use of more energy efficiency technologies and practices, which can help reduce energy costs. Existing state, federal, and utility incentives can help offset the initial upfront costs and help owners reap the long term benefits of energy savings.

Economic Development Opportunities in the Clean Energy Economy

Energy-related jobs currently represent a relatively small portion of Utah’s total employment, and the sector has undergone notable transformations over the past century, with a shift from extraction to systems and services. Renewable energy and energy efficiency are a small, yet growing, fraction of Utah’s energy sector. As the energy market continues to change, Utah has tremendous potential to expand and foster new employment and business activity in these sectors.

The clean energy economy is by nature more dispersed, with renewable energy and energy efficiency projects and development potential distributed across numerous counties, cities, and towns. To this extent, clean energy industries provide an additional economic benefit known as *import substitution*. Import substitution occurs when externally produced goods and services, especially basic necessities such as energy, food, and water, are replaced by those that are produced locally. By doing so, local communities can put their money to work within their boundaries. Energy is one of the largest externally-produced goods for many local economies – particularly in rural areas. With few exceptions, most energy dollars are sent out of local economies. Keeping this money within the community can have significant positive impacts, including increased demand for locally produced goods and services.

Shoshone Tribe's Deep Connection to the Earth Yields Profits

The Northwestern Band of Shoshone Economic Development Corporation ("NWB EDC"), through its division Shoshone Energy, is developing several large geothermal projects in the Western U.S. On October 2, 2008, the NWB EDC broke ground on the first phase of a 96 MW utility-scale geothermal power plant in Box Elder County, Utah. The project, aptly named Shoshone Renaissance, is slated to generate close to \$100 million a year for the Shoshone Tribe once all three phases are complete.¹

Leasing the land from local farmers, the tribe will tap into the earth's geothermal energy. Shoshone Renaissance is being built in three phases of 32 MW each, with Phase I commercial operation date scheduled for May 2010; Phase II in 2011; and Phase III reaching operation by 2012. The tribe negotiated a 30-year power purchase agreement with Riverside, California, for all three phases. The project will provide enough power to supply 30% of Riverside's base load electricity needs, or approximately 67,200 homes.²

The Shoshone are partnering with Idatherm and Ireland's LotusWorks to develop the plant, and Meridian Investments of Boston to secure financing. Michael Devine, CEO of The Shoshone Nation, says that geothermal energy will provide strong economic development.³ That will improve health care, housing, and education for the Shoshone tribe.⁴

Quick Facts:

Jobs Created: 200 construction, 25 operations and maintenance

Company: Shoshone Energy

Location: Brigham City, Utah

Project name: Shoshone Renaissance

Resource technology: Geothermal

Estimated project cost: \$450 million⁵

Annual revenue: Projected to be approximately \$100 million

Total capacity: 96 MW



*Shoshone Energy geothermal project groundbreaking
(credit: Sara Baldwin, Utah Clean Energy)*

¹Phone conversation with David Olive, General Manager, Shoshone Energy, January 14, 2009.

²Ibid.

³Shoshone: Poised for prosperity. Rick Egan. May 4, 2008. http://www.youtube.com/watch?v=IXct3Lf_ea0.

⁴Shoshone Tribe drilling for geothermal energy. Alex Cabrero. October 1, 2008. <http://www.ksl.com/?nid=148&sid=4415383>.

⁵Working with Mother Earth / Shoshone Nation breaks ground on geothermal plant in Honeyville. Di Lewis. October 3, 2008. <http://www.standard.net/live/news/144827>.

For example, a recent economic study conducted by Utah State University shows that of the over \$32.1 million invested in the Spanish Fork Wind Power Project, the project generated an economic benefit of more than \$4 million to the economy and will provide ongoing payments to landowners, property tax revenues to Utah County and revenues to the Nebo School District, as well as create new jobs in the community.⁶⁴

On a similar level, energy efficiency is an energy resource that stimulates significant local investments to provide the necessary labor and equipment needed to retrofit an existing building or increase the efficiency in new construction. According to a recent study by Management Information Services, conducted for the American Solar Energy Society, the “largest number of jobs that will be created in the [clean energy] sectors are related to

Spanish Fork Wind Turbines Generate Power and Profits in Utah

In 2008, Utah’s first commercial wind power development finally came to life in Spanish Fork, Utah, generating power and profits for the local economy.

The Spanish Fork Wind Power Plant was originally developed by Heber-based Wasatch Wind and then sold to Edison Mission Energy. Rocky Mountain Power is buying the power under a 20-year power purchase agreement.

The project provides 18.9 megawatts (MW) of generating capacity and is capable of providing power to approximately 6,000 homes.¹ In addition to new jobs, the project provides lease payments to landowners and increased property tax revenues to Spanish Fork City, Utah County, Central Utah Water Conservatory District and the Nebo School District.



Spanish Fork construction site. (credit: Sara Baldwin, Utah Clean Energy)

Quick Facts²

Jobs Created: 36 construction, 7 operation & maintenance

Project: Spanish Fork Wind Power Plant

Companies involved: Wasatch Wind, Rocky Mountain Power, & Edison Mission Energy

Location: Spanish Fork, Utah

Resource technology: Wind, Nine Suzlon S-88 turbines

Estimated project cost: Just over \$32.1 million

Estimated lease payments to landowners: \$74,000/year

Estimated property tax revenues for Utah County: \$112,000

Estimated revenues to Nebo School District: \$84,000/year

Total capacity: 18.9 MW

¹Jens Dana. *Spanish Fork hosting festivities to celebrate completion of wind farm.* Deseret News. 5 September 2008. URL: <http://deseretnews.com/article/1,5143,700256414,00.html>

² Draft Report: “Generating Economic Development from a Wind Power Plant in Spanish Fork Canyon, Utah: A Case Study and Analysis of State-Level Economic Impacts”. Sandra Reategui, National Renewable Energy Laboratory and Cathy L Hartman, Ph.D. and Edwin R. Stafford, Ph.D., Center for the Market Diffusion of Renewable Energy and Clean Technology, Jon M. Huntsman School of Business Utah State University. 19 August 2008.

energy efficient construction and green buildings.”⁶⁵ New and existing buildings in both rural and urban settings present a great opportunity for energy savings and job creation. In addition to providing work for those living in Utah’s growing cities, employment related to these basic energy efficiency improvements can generate much-needed rural economic development. Employing more energy efficiency in Utah’s building sector (both new construction and retrofits) is a strategy to stimulate Utah’s housing market and put Utahns back to work. Again,

keeping money circulating in the local economy helps Utah businesses and stimulates new jobs that cannot be outsourced.

Overall, growing Utah’s energy efficiency and renewable energy sectors will increase the scale and diversity of local economic development and local jobs, while creating additional benefits and opportunities for education and an improved quality of life for Utahns. Additionally, the Clean Energy Scenario provides significant water savings and reduction of greenhouse gas emissions.

Cost-Effective, Low-Income Clean Energy Housing

Salt Lake City is home to several low-income housing projects that feature a suite of energy efficiency measures combined with solar electric systems – the residents enjoy low rental fees and low utility bills, which helps them save money while reducing their energy impact. In 2007, the LaPorte Group, a Salt Lake City-based property management and construction firm, transformed the historic Stratford Hotel (ravaged in a fire) into a 46-unit apartment building dedicated to low-income residents designed to keep the cost of living down for the residents. The apartments feature rooftop photovoltaic solar panels (1 kilowatt per apartment), thick insulation, high-efficiency ENERGY STAR appliances and energy-efficient windows.

The LaPorte Group took advantage of a combination of state and federal tax credits and incentives make the renovations cost effective, including tax credits for low income housing, renewable energy and solar credits, along with Rocky Mountain Power rebates for energy efficient thermostats, furnaces, windows and ENERGY STAR appliances.

Quick Facts:

Average Utility: \$15 per month. The average utility cost for the same type of unit without such upgrades is \$45.

Investment: LaPorte invests about 15 – 18 percent of the total renovation costs. The rest is covered by numerous federal and state tax credits and incentives.



Solar PV units on roof of Ashby Apartments in Salt Lake City (credit: LaPorte Group)

¹Salt Lake Tribune, July 7, 2008 article: *Budget, Earth Friendly* (pg D12)² Interview with Ben Logue – Owner, LaPorte Properties

² Ibid

Distinct Investment Strategies

As noted in the Investment Section on page 18, the 20% Clean Energy Scenario and Reference Scenarios reflect two very distinct investment strategies to meet long-term energy needs and growth projection in Utah. The 20% Clean Energy Scenario entails higher up-front capital costs with significantly lower ongoing fuel costs, along with increased energy savings from increased energy efficiency measures. The Reference Scenario, alternatively, entails lower capital costs but considerably larger ongoing fuel costs. The energy efficiency in this scenario provides savings, but not nearly as much in a higher efficiency scenario. The clean energy investment strategy arguably reduces the exposure to volatile fuel costs and future carbon costs. The energy efficiency measures considered in the 20% Clean Energy Scenario are among the most cost-effective new resources available, and renewable energy is becoming increasingly cost-competitive with new resources on a levelized-cost basis. A comprehensive risk-benefit analysis of the two scenarios would provide additional quantifications to determine the overall impacts to Utah consumers and businesses.

Conclusion

The 20% Clean Energy Scenario is estimated to create nearly 7,000 more net ongoing jobs by 2020 than the GOPB Baseline predicts. For a similar level of investment, the 20% Clean Energy Scenario results in a net increase of 4,100 jobs, \$140 million of annual earnings and a \$20 million annual increase in GDPS relative to the Reference Scenario. The increase in jobs is due to the investments in renewable energy resources, designing, building and retrofitting energy efficient homes and businesses, and local spending of energy bill savings. Furthermore, the 20% Clean Energy Scenario provides a hedge against volatile fuel costs and future risks and uncertainties in a rapidly changing energy market.

This study presents a modest share of Utah's potential for new clean energy development, suggesting that the 20% Clean Energy Scenario is an excellent first step in meeting Utah's growing energy demand while mitigating risks to Utah businesses and citizens.

A pioneering spirit, leadership, and aggressive programs and policies to advance energy efficiency and renewable energy will help make Utah a leader in the new clean energy economy, while generating new high-quality jobs that cannot be outsourced and new economic development in Utah's rural and urban areas.

This report demonstrates that the creation of a clean energy economy in Utah will create more net ongoing jobs, more net annual earnings and comparable net GDPS by the year 2020 than the Reference Scenario through meeting our state's ambitious but achievable energy efficiency and renewable energy goals.



A massive wind turbine is lifted for installation at the Milford Wind Farm construction site. This wind project will be the largest renewable energy facility in Utah.

Photo Credit: Rob Adams

The 20% Clean Energy Scenario Saves Water and Reduces Carbon Emissions

The 20% Clean Energy Scenario uses less fossil fuel as compared to the Reference Scenario and thus significantly reduces carbon dioxide emissions associated with the burning of fossil fuels and the use of water needed to cool power plants. The graphs below show the carbon dioxide emission reduction and water savings in the electricity sector for the 20% Clean Energy Scenario as compared to the Reference Scenario. Both water consumption and carbon dioxide emissions are each reduced by approximately 22% as compared to the Reference Scenario. The water calculations account for water consumption in both fossil fuel facilities and renewable energy facilities. The 20% Clean Energy Scenario water savings are 3.4 billion gallons in 2020 which is equivalent to over 40% of Provo, Utah's 2008 residential water consumption. Carbon dioxide emissions in 2020 are reduced by nearly 5 million metric tons in the electricity sector alone; direct use natural gas savings will contribute to additional greenhouse gas reductions beyond those calculated here.

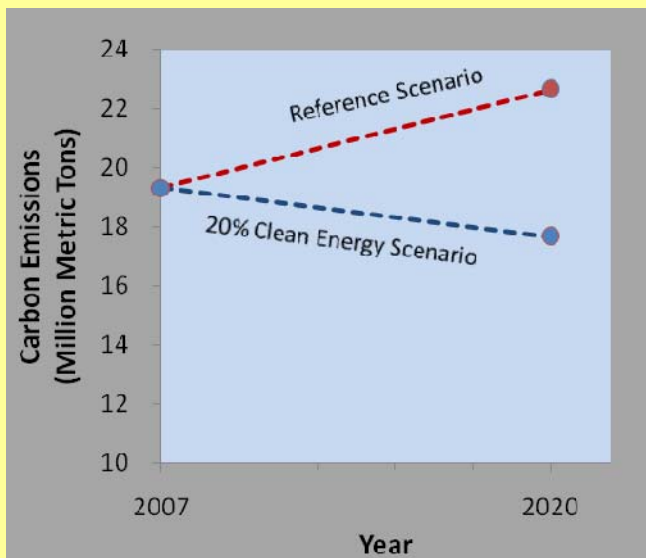


Figure 1 Utah Electricity Sector Carbon Emissions

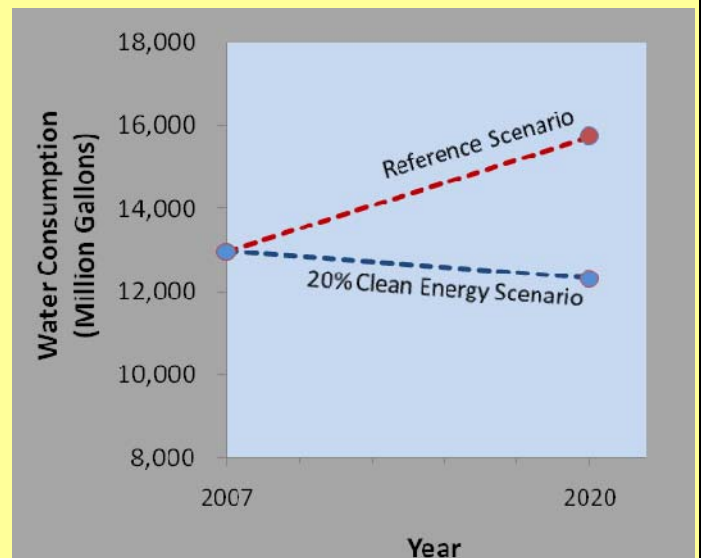


Figure 2 Utah Electricity Sector Water Consumption

Notes: Annual carbon dioxide emissions were calculated by multiplying each energy sources' average emission factor by the sources' projected annual output in GWH. Emission factors were derived by multiplying the source's average heat rate by its carbon coefficient. The average Utah heat rate for coal was provided by Michael Vanden Berg, Utah Geological Society. Carbon coefficients can be found in Tables 6-2 and 6-6 EIA, Documentation of Admissions of Greenhouse Gases in the United States for 2006, October 2008. URL: [http://www.eia.doe.gov/oiaf/1605/ggrpt/documentation/pdf/0638\(2006\).pdf](http://www.eia.doe.gov/oiaf/1605/ggrpt/documentation/pdf/0638(2006).pdf).

Annual water consumption by energy source was calculated by multiplying each energy sources' average water usage factor by the sources' projected annual output in GWH. Water usage factors for electricity resources were provided by Stacy Tellinghuisen of Western Resource Advocates. Residential water usage data can be found in Department of Natural Resources, Utah Division of Water Resources. "Municipal & Industrial Water Supplies Studies, Utah State Summary", 2000, p. 12-13. URL: <http://www.water.gov/m&i/pdf>.

Next Steps and Exploring the Frontier

While Utah's clean energy goals are a good first step in the right direction, Utah needs a comprehensive and collaborative statewide effort to significantly expand the adoption of energy efficiency and renewable energy outlined in the 20% Clean Energy Scenario and reap the associated economic development benefits. Utah must ramp-up efforts to stay competitive with rapidly growing national and global clean energy markets and attract new industries. Additionally, stakeholders from all sectors need to work together to overcome the remaining barriers and capitalize on existing opportunities. The following actions are critical to Utah's success in the clean energy sector:

Accelerate Energy Efficiency Retrofits and New High Performance Building

Utah can put its builders and contractors to work retrofitting existing homes and buildings, while mining the state's vast energy efficiency potential, which is hidden within inefficient buildings across the state. Utah should develop a comprehensive energy retrofit program that capitalizes on federal and utility incentives to retrofit at least 50% of the state's homes and buildings by 2015. For new construction, Utah must adopt the most current energy code (International Energy Conservation Code 2009), enforce energy code compliance uniformly, and develop programs to encourage beyond-code construction.

Demonstrate Government Leadership

From the executive branch to the local city zoning and planning commissions, elected officials must demonstrate commitment and leadership with respect to clean energy policies and investments. Renewable energy and energy efficiency industries, projects, and manufacturing facilities are consistently drawn to areas where government is leading the way.

Remove Regulatory and Policy Barriers

Clean energy industries, businesses, and utilities all face regulatory and policy barriers to increased energy efficiency and renewable energy development in Utah. Elected officials, regulators, utilities, consumer interest groups, and businesses must work together to proactively address these barriers and foster a business-friendly environment that also meets the needs of consumers and

the utilities. Removing these barriers drives economic development, creates new jobs, and encourages adoption of clean energy across the state.

Train Utah's Clean Energy Workforce

A trained workforce is essential to achieving the 20% Clean Energy Scenario. In 2009, the Utah Department of Workforce Services, state institutions of higher education, Utah utilities, Utah Clean Energy and the Governor's Office of Economic Development commenced an initiative to expand and train Utah's clean energy workforce. This initiative is a tremendous first step that warrants the long-term attention and dedication from all parties. Developing the training, certification, and educational forums to provide the skills and expertise for efficiency and renewable energy will stimulate Utah's economy, put people to work, and meet the workforce demands of Utah businesses.

Expand Public Education and Outreach

Informed consumers and business owners are much more likely to make educated energy decisions. Utah should expand existing public education efforts to help make energy efficiency and renewable energy a part of mainstream consumer awareness and help inform energy decisions and habits.

Adopt Competitive Incentives and Policies

Utah's current state and utility incentives for energy efficiency and renewable energy play an important role in spurring the adoption of clean energy; however, Utah should continue to identify and adopt policies, programs, and incentives to attract clean energy industries and projects in order to become competitive with surrounding states. Some examples of incentives and policies include financial payments, tax credits, utility rebates, feed-in tariffs, firm clean energy portfolio standards, expedited permitting and model ordinances, and property tax parity with other energy resources.

Enable Innovative Financing

Just as mortgages facilitate home ownership, innovative clean energy financing mechanisms enable more Utahns to adopt renewable energy and energy efficiency by

Today, Utah stands poised to capitalize on the clean energy frontier, and the future is well within reach.

removing the up-front cost barrier. Unlike other energy resources, renewables and efficiency are fuel-free resources that have higher up-front capital investments but no long-term fuel investments; as such, they require unique financing options. Utah should remove institutional barriers to clean energy financing and adopt creative mechanisms that have been successful in other states. Examples include third party financing for large-scale renewable energy projects, lease options for distributed generation, longer-term financing for industrial energy efficiency measures, and municipal-level property assessed clean energy financing for the residential and commercial sectors.

Utah's Clean Energy Future

While not exhaustive, the aforementioned actions and policy measures can be implemented immediately with today's technologies and resources. Widespread adoption of energy efficiency and renewable energy will enable Utahns across all sectors to reap the benefits of these technologies, while broadly expanding Utah's economic opportunities. Rather than lag behind other states, Utah can proactively recruit and develop clean energy industries and projects. Indeed, Utah's resourcefulness and pioneering spirit, along with a unified commitment and clean energy goals, provide a strong foundation upon which to build the state's clean energy economy. Today, Utah stands poised to capitalize on the clean energy frontier, and the future is well within reach.

Endnotes

¹Governor Huntsman’s Utah Policy to Advance Energy Efficiency in the State. URL: <http://www.energy.utah.gov/documents/Utah%20EE%20policy.pdf>.

²Utah Code § 54-17-602. Under this statute, the target was established for Utah’s municipal, investor-owned, and cooperative utilities to provide 20% of their adjusted retail electric sales from qualifying non-carbon based energy resources by 2025, if cost-effective. Utah Code § 54-17-602(1).

³Although the renewable goal under the statute cited above is 20% renewable energy by the year 2025. The year 2020 was selected as the model year for this study to coincide with energy efficiency data from the Utah Energy Efficiency Strategy Report which goes out to 2020. Furthermore, the Utah electricity projected sales growth and capacity requirement data from PacifiCorp’s 2007 IRP process goes out to the year 2017 and therefore only required extrapolating three years to 2020, rather than eight years to 2025.

⁴Wikstrom, K. “Ski Utah Report,” season 2007-2008. Prepared by Wikstrom Economic and Planning Consultants.

⁵Brown, R., Borgeson, S., Koomey, J., Biermayer, P., “U.S. Building-Sector Energy Efficiency Potential,” September, 2008. <http://enduse.lbl.gov/info/LBNL-1096E.pdf>.

⁶Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R, “Utah Renewable Energy Zones Task Force Phase I Report: Renewable Energy Zone Resource Identification,” December 2008. URL: http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf.

⁷Chaudhari, M.; Frantzis, L.; Hoff, T.E., “PV Grid Connected Market Potential in 2010 under a Cost Breakthrough Scenario,” prepared by Navigant Consulting for the Energy Foundation, September, 2004.

⁸Energy Strategies assisted with the initial development and review of the inputs and scenarios analyzed in this study. All of these inputs were peer-reviewed by numerous Utah and national energy stakeholders, whose feedback was greatly appreciated (see acknowledgements).

⁹2007 PacifiCorp Integrated Resource Plan. URL: <http://www.pacificorp.com/File/File74765.pdf>, 2007 PacifiCorp Integrated Resource Plan Appendices, URL: <http://www.pacificorp.com/File/File74766.pdf> and 2007 PacifiCorp Integrated Resource Plan Update, URL: <http://www.pacificorp.com/File/File82304.pdf>.

¹⁰The purpose for utilizing PacifiCorp’s electricity resource planning documents for this scenario is that PacifiCorp, an investor-owned utility, serves roughly 80 percent of the State of Utah.

The remainder of the state is serviced in large part by municipal power systems or rural electric cooperatives such as Murray City Power and Garkane Power.

¹¹Governor’s Office of Planning and Budget. URL: <http://governor.utah.gov/dea/>.

¹²See reference 4.

¹³Roger H. Bezdek, “Green Collar Jobs in the U.S. and Colorado: Economic Drivers for the 21st Century,” Management Information Systems for the American Solar Energy Society, 2009, p.4. For comparison, the previous year (2006) renewable energy and energy efficiency represented 8.5 million jobs and \$972 billion in revenue. The job figures reflect jobs in sectors such as transportation and recycling, which were not evaluated in this study. URL: http://www.ases.org/images/stories/ASES/pdfs/CO_Jobs_Rpt_Jan2009_summary.pdf.

¹⁴Includes “The Clean Energy Economy: Repowering Jobs, Investments and Businesses Across America,” The Pew Charitable Trusts, June 2009. http://www.pewcenteronthestates.org/uploadedFiles/Clean_Economy_Report_Web.pdf.

¹⁵Clendenin, J., “Wind Energy Grows By Record 8,300 MW in 2008,” January 28, 2009. American Wind Energy Association Press Release. URL: http://www.awea.org/newsroom/releases/wind_energy_growth2008_27Jan09.html.

¹⁶Ibid

¹⁷Larry Sherwood, “2007 U.S. Solar Market Trends,” Interstate Renewable Energy Council, August 2008. http://www.irecusa.org/fileadmin/user_upload/NationalOutreachPubs/IREC%20Solar%20Market%20Trends%20August%202008_2.pdf

¹⁸See Reference 1

¹⁹See Reference 2

²⁰See Reference 3

²¹Geller, H., Baldwin, S., Emerson, K., Wright, S., Case, P., Langer, T., “Utah Energy Efficiency Strategy: Policy Options,” October 2007. URL: http://energy.utah.gov/energy/utah_energy_efficiency_strategy.html. Only the savings and investments in the year 2020 were modeled in this analysis. The cost and saving assumptions for each efficiency program were used to calculate the investment and savings values used in this study. The programs analyzed are not prescriptive policy recommendations, but are quantified examples of the types of measures and associated investments that could be employed to achieve the Utah’s energy efficiency goal.

²²2007 PacifiCorp Integrated Resource Plan, URL: <http://www.pacificorp.com/File/File74765.pdf>, <http://www.pacificorp.com/File/File74766.pdf>.

²³2007 PacifiCorp Integrated Resource Plan Update, URL: <http://www.pacificorp.com/File/File82304.pdf>.

²⁴Utah Geological Survey. "Utah Energy Statistics, Overview of U.S. and Utah Energy Trends", 2008, Table 1.10 - Net Generation of Electricity in Utah by Energy Source, 1960-2008. URL: <http://geology.utah.gov/emp/energydata/overviewdata.htm>.

²⁵2007 PacifiCorp Integrated Resource Plan, Figure 1.3, URL: <http://www.pacificorp.com/File/File74765.pdf>.

²⁶See Reference 1 and 2

²⁷Utah State of the State 2009. URL: http://www.utah.gov/governor/news_media/article.html?article=2301.

²⁸This calculation assumes a 750 kWh/month average household usage.

²⁹U.S. Energy Information Administration, as cited by Architecture 2030, The Building Sector. URL: http://www.architecture2030.org/current_situation/building_sector.html.

³⁰Energy Star Homes, URL: www.energystar.gov/index.cfm?c=new_homes.hm_index.

³¹In September, 2008 an updated International Energy Conservation Code (IECC) was approved at a meeting of the International Code Council. This code, the IECC 2009, will automatically be adopted by the state of Utah in 2010 and has the potential to greatly improve the energy efficiency of Utah buildings. Note: the IECC 2009 was not analyzed.

³²See Reference 6.

³³Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," 2009, Table 9, p. 20 and Wind Sites Identified, p. 22.

³⁴Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," pg 2. URL: http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf. These figures reflect the exclusionary screening process of the UREZ effort; all lands under the jurisdiction of federal, state, or local governments that restrict development of typical large-scale projects were screened out of the analysis. These areas are environmentally sensitive lands, military training grounds or airspace, national parks, state parks, state

wildlife reserves, wilderness study areas, etc (see pages 16-26 of the report for additional details).

³⁵Assumes an average Utah home electricity usage of 750 kWh/month.

³⁶"Wind Power for Rural Economic Development", U.S. Department of Energy and the National Renewable Energy Laboratory Wind Powering America Program. URL: http://www.windpoweringamerica.gov/pdfs/wpa/33590_econ_dev.pdf.

³⁷Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," 2009, Executive Summary, p. 3. URL: http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf.

³⁸S. Department of Energy Solar Technologies Program, Concentrating Solar Power. URL: <http://www1.eere.energy.gov/solar/csp.html>.

³⁹Sandia National Laboratories. National Solar Thermal Test Facility. URL: http://www.sandia.gov/Renewable_Energy/solarthermal/NSTTF/salt.htm.

⁴⁰Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," 2009, Figure 11, p. 15. URL: http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf. The solar analysis used several criteria to shape the methodology: (1) measurements of Direct Normal Irradiance (DNI), with a threshold value of 6.0 kilowatt hours per meter squared (kWh/m²)/day or greater, (2) screening out steeper areas (slopes of 3% or greater) unable to accommodate a large solar collection field, (3) screening out environmentally sensitive areas such as national parks, wilderness areas, wetlands, etc., that are not available for development, and (4) applying proxy technology, of a 50 megawatt (MW) parabolic trough concentrating solar thermal power plant, to estimate electrical energy capacity. See pp. 11-15 for details.

⁴¹Chaudhari, M.; Frantzis, L.; Hoff, T.E., "PV Grid Connected Market Potential in 2010 under a Cost Breakthrough Scenario," September, 2004, p. 84. Prepared by Navigant Consulting for the Energy Foundation. URL: <http://www.ef.org/documents/EF-Final-Final2.pdf>.

⁴²Assumes 1 kW generates 1400 kWh/year and 16% capacity factor; assumes an average Utah household usage of 750 kWh/month.

⁴³Does not include incineration of municipal waste.

⁴⁴Utah Geological Survey, "Current and Proposed Renewable

Energy Facilities in the State of Utah,” Table 6.7. Updated January 13, 2009. URL: <http://geology.utah.gov/emp/energydata/renewenergydata.htm>.

⁴⁵Koerner, J.. “Multi-Tasking Recycling Plant for Farmers,” Winter 2006. Utah State Magazine, Utah State University. Volume 12, No. 4. URL: <http://www.utahstate.usu.edu/issues/winter06/methane.htm>.

⁴⁶Western Resource Advocates, “Renewable Energy Atlas of the West,” 2002, p. 12. Calculated by adding the generation potential for landfill gas, crop residues, forest and mill waste and animal waste. 140 MW calculated by assuming 80% capacity factor for the 1,000 GWh/yr of generation potential listed in Figure shown on p. 12.

⁴⁷Energy Strategies assisted with the initial development and review of the inputs and scenarios analyzed in this study. All of these inputs were peer-reviewed by numerous Utah and national energy stakeholders whose feedback was greatly appreciated.

⁴⁸2007 PacifiCorp Integrated Resource Plan. URL: <http://www.pacificorp.com/File/File74765.pdf>, <http://www.pacificorp.com/File/File74766.pdf> and 2007 PacifiCorp Integrated Resource Plan Update, <http://www.pacificorp.com/File/File82304.pdf>.

⁴⁹See Reference 10.

⁵⁰See Reference 21.

⁵¹2007 PacifiCorp Integrated Resource Plan. URL: <http://www.pacificorp.com/File/File74765.pdf>, <http://www.pacificorp.com/File/File74766.pdf>.

⁵²2007 PacifiCorp Integrated Resource Plan Update. URL: <http://www.pacificorp.com/File/File82304.pdf>.

⁵³See online Appendix, Table 6, *Utah Portfolio Scenarios* spreadsheet (Cell EC172 in 20% Clean Energy Scenario tab and Cell EM106 in Reference tab).

⁵⁴Please see Table “Reference Scenario: New Capacity and Investment costs to Utahns for new resources (2007-2020)” in the online appendix.

⁵⁵http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/central.html.

⁵⁶State of Utah Regional Impacts Model (“RIMS”).

⁵⁷Trends based on data from the U.S. Bureau of Labor Statistics *Economic and Employment Projections 1996, 2006 and 2016*,

suggest that productivity rates are expected to vary widely among sectors.

⁵⁸Renewable energy is assumed to be financed with bank loans carrying an average 10 percent interest rate over a twenty year period. Approximately 80 percent of the investment in efficiency will be financed by bank loans carrying an average interest rate of 10 percent over five years.

⁵⁹For further details of all results, please see the online appendix.

⁶⁰See Reference 4.

⁶¹Wind Turbine Maker Vestas to Add 1,350 Colorado Jobs. CBS 4 Denver. August 16, 2008. URL: <http://cbs4denver.com/seenon/vestas.colorado.wind.2.796234.html>.

⁶²For details, please see Online Appendix, Spreadsheet 4 *All Tables and Graphs* spreadsheet, URL: http://utahcleanenergy.org/utah_economic_development_study/appendix.

⁶³American Solar Energy Society (ASES) and Management Information Services, Inc (MISI), “Green Collar Jobs in the U.S. and Colorado,” 2009, p. 48.

⁶⁴Penrod, S., “Wind project generates economic windfall for Utah”. *KSL Channel 5 News*. January 27, 2009. URL: <http://www.ksl.com/?nid=148&sid=5436853> and Rategui, Sandra, E. Stafford, C. Hartman, “Generating Economic Development from a Wind Power Project in Spanish Fork Canyon, Utah: A Case Study and Analysis of State-Level Economic Impacts.” Center for the Market Diffusion of Renewable Energy and Clean Technology Jon M. Huntsman School of Business Utah State University. January 2009 DOE/GO-102009-2760. URL: <http://media.bonnint.net/slc/917/91737/9173767.pdf>.

⁶⁵Bezdek, R., “Green Collar Jobs in the U.S. and Colorado,” 2009, p. 60. Prepared by the American Solar Energy Society (ASES) and Management Information Services, Inc (MISI). URL: http://www.ases.org/images/stories/ASES/pdfs/CO_Jobs_Rpt_Jan2009_summary.pdf. It is important to note that the Energy Efficiency sector analyzed in this study includes the transportation sector and recycling, both of which were not evaluated in this analysis.

⁶⁶Havnes, M. “Wind farm fans green hopes,” *The Salt Lake Tribune*, November 11, 2009.

⁶⁷Energy Strategies provides consulting services to energy consumers and independent energy producers. For over 20 years, Energy Strategies has provided strategic and tactical support to Clients with respect to the purchase and sale of electricity and

gas, investment in energy infrastructure and technology, energy project development, and energy regulation and policy. See <http://www.energystrat.com/> for additional information.

⁶⁸2007 PacifiCorp Integrated Resource Plan. URL: <http://www.pacificorp.com/File/File74765.pdf>, <http://www.pacificorp.com/File/File74766.pdf>.

⁶⁹2007 PacifiCorp Integrated Resource Plan Update. URL: <http://www.pacificorp.com/File/File82304.pdf>.

⁷⁰2008 PacifiCorp Integrated Resource Plan Public Meeting on May 22, 2008. URL: <http://www.pacificorp.com/File/File81689.pdf>.

⁷¹Wiser, R., Bolinger, M., Cappers, P., Margolis, M. "Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California," January, 2006. URL: <http://eetd.lbl.gov/ea/EMP/reports/59282.pdf>. Assumes residential PV cost of \$10,000/KW in 2008, and a 5 percent decrease in cost from 2008-2020, "The \$10,000/KW cost is based on several phone calls to local installers.

⁷²Biomass costs were from the Renewable Energy Transmission Initiative, Phase 1a, Final Report, May 2008. URL: <http://www.energy.ca.gov/2008publications/RETI-1000-2008-002/RETI-1000-2008-002-F.PDF>. Produced by Black & Veatch.

⁷³Senate Bill 202 ("The Energy Resource and Carbon Emission Reduction Initiative," signed into law during the 2008 Utah Legislative Session) establishes a target for Utah to have 20 percent of its electricity sales from renewable resources by 2025. The target was established for Utah's municipal, investor-owned, and cooperative utilities to provide 20 percent of their adjusted retail sales from qualifying non-carbon based energy resources by 2025, if cost-effective. Source: Reference Utah Code 54-17-602; and Governor Jon Huntsman Jr.'s 2006 Policy to Advance Energy Efficiency in the State calls for a 20 percent increase in energy efficiency across all sectors by 2015 - Source: Governor Huntsman's Utah Policy to Advance Energy Efficiency in the State. URL: www.energy.utah.gov/energy/governors_priorities/utah_policy_to_advance_energy_efficiency_in_the_state.html.

⁷⁴Geller, H., Baldwin, S., Emerson, K., Wright, S., Case, P., Langer, T. "Utah Energy Efficiency Strategy: Policy Options." October 2007. URL: http://www.utah.gov/energy/docs/UT_EE_Strategy_Final_Report_10-01-07.pdf. See also online appendix, Spreadsheet 7: "EE Inputs" and also Spreadsheets 8-15, URL: http://utahcleanenergy.org/utah_economic_development_study/appendix

⁷⁵Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," 2009, p. 2. URL:

http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf. These figures reflect the exclusionary screening process of the UREZ effort; all lands under the jurisdiction of federal, state, or local governments that restrict development of typical large-scale projects were screened out of the analysis. These areas are environmentally sensitive lands, military training grounds or airspace, national parks, state parks, state wildlife reserves, wilderness study areas, etc (see pages 16-26 of the report for additional details). See endnote #54 above.

⁷⁶"Geothermal Task Force Report," January 2006. Western Governor's Association. URL: <http://www.westgov.org/wga/initiatives/cdeac/Geothermal-summary.pdf>.

⁷⁷Berry, J., Hurlbut, D., Simon, R., Moore, J., Blackett, R., "Utah Renewable Energy Zone Task Force Report," 2009, Executive Summary, p. 3. URL: http://geology.utah.gov/sep/renewable_energy/urez/pdf/mp-09-1low.pdf.

⁷⁸See Reference 40.

⁷⁹See Reference 41.

⁸⁰Email from Brian Cuzzone, team leader, U.S. EPA Landfill Methane Outreach Program, August 21, 2006.

⁸¹2007 PacifiCorp Integrated Resource Plan Update, Table 9, p.15. URL: <http://www.pacificorp.com/File/File82304.pdf>.

⁸²SNL Financial List of PacifiCorp's Operating Power Plants 2007.

⁸³The ongoing energy planning concern for PacifiCorp is to meet the large demand in energy during peak hours, typically summertime late afternoon. This challenge is reflected in planning for peak capacity, which is why that was the basis for developing the scenarios.

⁸⁴2007 PacifiCorp Integrated Resource Plan, Table 1.3, p.8. URL: <http://www.pacificorp.com/File/File74765.pdf>.

Appendix A

Acronyms and Abbreviations

Btu	British thermal unit
CCNG	combined cycle natural gas
CFL	compact fluorescent light-bulb
CSP	concentrating solar power
CO2	carbon dioxide
Co-ops	Rural electric cooperatives
DSM	demand-side management
DOE	(United States) Department of Energy
EDCUtah	Economic Development Corporation of Utah
EE	energy efficiency
EE/RE	energy efficiency and renewable energy
GDPS	Gross Domestic Product by State
GW	Gigawatt
GWh	Gigawatt-hour
GOBP	Governor’s Office of Planning and Budget
H₂O	water
HVAC	heating, ventilation, air-conditioning and cooling
IMPLAN	IMpact analysis for PLANning
IRP	Integrated Resource Plan
kW	kilowatt
kWh	kilowatt-hour
Munis	municipal electric utilities
MW	Megawatt
MWh	Megawatt-hour
O&M	operation and maintenance
PV	Solar Photovoltaic
PSC	Public Service Commission
QGC	Questar Gas Company
RIMS	Regional Impacts Model, State of Utah
RMP	Rocky Mountain Power
SCNG	Simple Cycle Natural Gas
SWEEP	Southwest Energy Efficiency Project
T&D	transmission and distribution
UREZ	Utah Renewable Energy Zones
USTAR	Utah Science Technology and Research Initiative
WGA	Western Governors Association

Definition of Terms

Anaerobic digestion (bio-digesters): A biochemical process in which particular kinds of bacteria digest biomass in an oxygen-free environment to break down complex organic wastes in stages, resulting in the production of biogas. The biogas can then be used to generate heat and electricity.

Capacity factor: The ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the

same period.

Capacity value: The capacity value is the percentage of nameplate capacity that, for planning purposes, is relied upon to meet peak demand. For this analysis, all capacity values were used to determine the contribution to the State’s growing capacity demands of the aforementioned resources.

Capital costs: A one-time setup/construction cost of a plant or project, after which there will only be recurring operational or running costs.

Concentrating solar power (CSP): A solar energy conversion system characterized by the optical concentration of solar rays through an arrangement of mirrors to generate a high temperature working fluid. Concentrating solar power may also refer to a system that focuses solar rays on a photovoltaic cell to increase conversion efficiency.

Demand-side management (DSM): Demand side management consists of utility policies, programs and measures that are designed to control and reduce energy use and demand by residential, commercial and industrial customers. DSM reduces energy consumption while preserving or improving the quality and service of delivered energy, and the comfort of energy customers. Examples of DSM include utility rebate and shared savings activities for the installation of energy efficient appliances, lighting and electrical machinery, and weatherization materials. In addition, this category may include all other activities such as thermal storage, time-of-use rates, fuel substitution, measurement and evaluation, and any other utility-administered demand-side activities designed to reduce demand and/or energy use.

Energy efficiency: A means to reduce demand for energy of any type, generally through substituting more advanced technological equipment or alternative practices, while providing the same (or better) quality products and services. Common energy efficiency measures include high efficiency appliances, lighting, heating and cooling systems, improved insulation, day-lighting, and advanced building controls, efficient building design, advanced electric motor drives, and heat recovery systems.

ENERGY STAR®: A government-backed labeling program that identifies superior energy efficiency ratings in a myriad of products including; office equipment, home appliances, electronics and buildings.

Gasification: A method for converting coal, petroleum, biomass, wastes, or other carbon-containing materials into a gas that can be burned to generate power or processed into chemicals and fuels.

Gross Domestic Product by State (GDPS): The value of final goods and services produced by the labor and property located in a state; it is the state counterpart to the national Gross Domestic Product.

Import substitution: When externally produced goods and services are replaced by those that are produced locally, especially basic necessities such as energy, food, and water.

Integrated Resource Plan (IRP): A 10-year plan filed with the Public Service Commission that outlines how the utility will meet anticipated long-term customer needs. The plan evaluates a full range of options that a utility has to provide adequate and reliable service to electric consumers at the least cost and risk to the consumer.

Investment costs: The amount of money expended in an investment.

Job: Sufficient wages to employ one person full-time for one year.

Pyrolysis: The thermal decomposition of biomass at high temperatures (greater than 400° F, or 200° C) in the absence of air. The end product of pyrolysis is a mixture of solids (char), liquids (oxygenated oils), and gases (methane, carbon monoxide, and carbon dioxide) with proportions determined by operating temperature, pressure, oxygen content, and other conditions.

Renewable energy: Energy resources that are naturally replenishing but may be flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include: biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

Definitions of Key Energy Units

Btu: British Thermal Unit. Unit of energy measurement, namely the quantity of heat required to raise the temperature of one pound of water by one degree

Fahrenheit.

Kilowatt: Unit of electric power equal to one thousand watts.

Megawatt: Unit of electric power equal to one million watts.

Gigawatt: Unit of electric power equal to one billion watts.

Kilowatt-hour (kWh): A measure of electricity equivalent to one kilowatt of power expended for one hour. The average Utah household consumes 9,650 kWh of electricity per year.

MWH: Unit of electricity equal to one thousand kilowatt-hours.

GWh: Unit of electricity equal to one million kilowatt-hours.

Therm: Unit of natural gas measurement, equal to 100,000 Btus and approximately equivalent to the energy content of 100 cubic feet of natural gas. The average Utah household consumes about 800 therms of natural gas per year.

Decatherm: Unit of natural gas measurement equal to 10 therms or one million Btus.

Appendix B

Summary of Assumptions and Model Inputs

	Natural Gas		Wind	Solar			Geo-thermal	Biomass		
	Simple Cycle	Combined Cycle		Residential	Commercial	CSP with Storage		Solid	Anaerobic Digestion	Landfill Gas
Capacity Value	100%	100%	20% ¹	75.00%	75%	100%	100%	100%	100%	100% ³
Out-of-State Capacity Factor	-	-	38% ²	-	-	-	-	-	-	-
In-State Capacity Factor	5%	56% ¹	29% ²	16% ³	16% ³	47% ²	96% ¹	80% ⁴	80% ⁴	80% ⁴
Capital Cost (\$)	\$1040 ²	\$1,504 ²	\$2268 ²	\$10,000 ²	\$7,500 ⁵	\$4350 ²	\$5038 ²	\$3750 ⁴	\$5000 ⁴	\$1600 ⁴
Capital Cost 2010-2014 (\$)	-	-	-	\$9025 ⁵	\$6219 ⁶	-	-	-	-	-
Capital Cost 2015-2019 (\$)	-	-	-	\$6983 ⁵	\$4670 ⁶	-	-	-	-	-
Capital Cost 2020 (\$)	-	-	-	\$5404 ⁵	\$3658 ⁶	-	-	-	-	-
Fixed O&M (\$/kW-yr)	\$6.28 ¹	\$16.92 ¹	\$32.28 ¹	\$100 ⁵	\$100 ⁵	\$32.10 ¹	\$23.10 ¹	\$83.00 ⁴	\$0.00 ⁴	\$0.00 ⁴
Variable O&M (\$/kW-yr)	\$10.86 ⁵	\$2.60 ¹	\$0.00 ¹	\$0.00 ⁵	\$0.00 ⁵	\$3.10 ¹	\$5.50 ¹	\$11.00 ⁴	\$17.00 ⁴	\$17.00 ⁴
Fuel Cost (\$)	\$8.63 ⁷	\$8.63 ⁷	-	-	-	-	-	\$1.00 ⁴	\$2.00 ⁴	\$2.00 ⁴
Heat Rate (BTU/kWh)	9647 ¹	8869 ²	-	-	-	-	-	15,750 ¹	13,000 ⁴	13,500 ⁴
Plant Size (MW)	79 ¹	222 ²	-	-	-	-	-	-	-	-
Fuel Cost in 2020 (\$)	\$8.63 ⁷	\$8.63 ⁷	-	-	-	-	-	-	-	-

Notes

1 PacifiCorp 2007 IRP

2 PacifiCorp 2008 Integrated Resource Plan Public Meeting, May 22, 2008, p. 28. <http://www.pacificorp.com/File/File81689.pdf>

3 Liz Brown, National Renewable Energy Lab, Memo to PacifiCorp, June 16, 2008

4 Renewable Energy Transmission Initiative, Phase 1a, Final Report, May 2008, Black & Veatch Project: 149148. Prepared for RETI Coordinating Committee, RETI Stakeholder Steering Committee.

5 "Assessment of Long-Term, System-Wide Potential for Demand-Side and Other Supplemental Resources," Quantec prepared for PacifiCorp, July 11, 2007. <http://www.pacificorp.com/File/File75533.pdf>, <http://www.pacificorp.com/File/File75534.pdf>

6 Assumes commercial PV cost of \$7,500/KW and \$10,000/KW in 2008 for commercial and residential pv (which are based on several phone calls to local installers) and a 5% decrease in cost from 2008-2020 ("Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California," Ryan Wiser, Mark Bolinger, Peter Cappers, and Robert Margolis, January 2006; Download from [http://eetd.lbl.gov/EA/EMPWiser and Bollinger](http://eetd.lbl.gov/EA/EMPWiser%20and%20Bollinger)).

7 Mark Bolinger and Ryan Wiser, Berkeley Lab (LBNL), Memo entitled "Comparison of AEO 2008 Natural Gas Price Forecast to NYMEX Futures Prices," January 7, 2008.

PacifiCorp's % of Utah Sales	Utah's % of total PacifiCorp System Sales	Utah's % of total PacifiCorp System Coincidental Peak Demand Capacity	GWh - 2007 Utah Available Energy	Utah's Projected Sales Growth after Demand Side Management	Reference Energy Efficiency Case: Percentage of sales met through DSM in 2020	Planning Reserves	Line losses
81% ¹	42% ²	47% ²	31104 ³	2.7% ⁴	7.5% ⁵	12% ²	10% ⁶

Notes

1 Energy Information Administration, Form 861 and Table 2. http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html

2 PacifiCorp 2007 IRP Update

3 SNL Financial List of PacifiCorp's Operating Power Plants 2007

4 PacifiCorp 2007 IRP and PacifiCorp 2008 IRP

5 PacifiCorp data request. Response from Pete Eelkima, July 8, 2008.

6 PacifiCorp 2007 IRP

Table B3: Reference Scenario: Year 2020 New Investments in the Electricity Sector--Inputs for the Model

	Capacity Developed (MW)	Capital (Million 2006\$)	O&M (Million 2006\$)	Fuel (Million 2006\$)	Total (Million 2006\$)
In-State Utah Investment					
Wind	0	\$0	\$1	\$0	\$1
Residential Solar PV	0.1	\$0.3	\$0.1	\$0	\$0
Commercial Solar PV	0	\$0.5	\$0.2	\$0	\$1
Solar CSP	0	\$0	\$0	\$0	\$0
Geothermal	0	\$0	\$5	\$0	\$5
Solid Biomass	0	\$0	\$0	\$0	\$0
Anaerobic Digestion					
Biomass	0	\$0	\$0	\$0	\$0
Landfill Gas Biomass	0	\$0	\$1	\$2	\$3
Simple Cycle Natural Gas	0	\$0	\$0	\$0	\$0
Combined Cycle Natural Gas	0	\$0	\$36	\$458	\$494
Sub-Total Utah Investment	0	\$1	\$44	\$460	\$504
Out-of-State Investment					
Out of State Wind	0	\$0	\$30	\$0	\$30
Out of State Combined Cycle Natural Gas	0	\$0	\$30	\$382	\$412
Out of State Front Office Transactions	1004	N/A	N/A	N/A	\$0
Sub-Total Out of State Investment	1004	\$0	\$60	\$382	\$442
Total Investment	1004	\$1	\$104	\$841	\$946

Note: Grayed out areas are not inputs and are presented for completeness. Out of state resources are not modeled and are not an input. Fuel investments are modeled in this scenario to capture the economic development related to increased fuel demand from natural gas plants.

Table B4: 20% Clean Energy Scenario: NET Year 2020 New Investments in the Electricity Sector Compared to Reference Scenario--Inputs for the Model

	Net Capacity Developed (MW)	Net Capital (Million 2006\$)	Net O&M (Million 2006\$)	Net Fuel (Million 2006\$)	Net Total (Million 2006\$)
In-State Utah Investment					
Wind	38	\$86	\$14	\$0	\$100
Residential Solar PV	1	\$7	\$1	\$0	\$8
Commercial Solar PV	6	\$24	\$7	\$0	\$31
Solar CSP	0	\$0	\$5	\$0	\$5
Geothermal	22	\$111	\$13	\$0	\$124
Solid Biomass	1	\$4	\$1	\$1	\$6
Anaerobic Digestion Biomass	1	\$5	\$1	\$1	\$7
Landfill Gas Biomass	0	\$0	\$1	\$1	\$2
Simple Cycle Natural Gas	0	\$0	\$1	\$3	\$4
Combined Cycle Natural Gas	0	\$0	-\$36	-\$458	-\$494
Total In-State Utah Investment	\$70	\$236	\$7	-\$451	\$243
Out-of-State Investment					
Wind	40	\$90	-\$9	\$0	\$81
Combined Cycle Natural Gas	0	\$0	-\$16	-\$199	-\$214
Front Office Transactions	-1004	N/A	N/A	N/A	\$0
Sub-Total Investment	-964	\$90	-\$24	-\$199	-\$133
Total Investment	-894	\$326	-\$17	-\$650	-\$342

Note: Grayed out areas are not inputs and are presented for completeness. Out of state resources are not modeled and are not an input, nor are the impacts to decreased fuel use since demand for Utah natural gas is assumed to stay constant.

Table B5: Year 2020 Energy Efficiency Savings and Investments --Inputs for the Model						
	Reference Scenario		20% Clean Energy Scenario			
	Savings in 2020 (Million 2006 \$)	Investments in 2020 (Million 2006 \$)	Savings in 2020 (Million 2006 \$)		Investments in 2020 (Million 2006 \$)	
	Total	Total	Total	Net over Reference	Total	Net over Reference
2007 Reference electric utility (DSM)	\$181.2	\$119.7	\$181.2	\$0.0	\$119.7	\$0.0
2007 Reference gas utility DSM	\$60.1	\$16.6	\$60.1	\$0.0	\$16.6	\$0.0
Expanded electric utility DSM	\$0.0	\$0.0	\$78.5	\$78.5	\$51.9	\$51.9
Expanded gas utility DSM	\$0.0	\$0.0	\$68.6	\$68.6	\$21.9	\$21.9
Upgrade building codes	\$0.0	\$0.0	\$169.8	\$169.8	\$135.3	\$135.3
Residential Energy Conservation Ordinances (RECOs)	\$0.0	\$0.0	\$31.2	\$31.2	\$14.3	\$14.3
Lamp standards	\$0.0	\$0.0	\$145.1	\$145.1	\$7.0	\$7.0
Low-income weatherization	\$0.0	\$0.0	\$24.9	\$24.9	\$10.3	\$10.3
Industrial challenge and recognition	\$0.0	\$0.0	\$110.5	\$110.5	\$26.1	\$26.1
State agency requirements	\$0.0	\$0.0	\$38.0	\$38.0	\$8.8	\$8.8
Local government and schools	\$0.0	\$0.0	\$30.7	\$30.7	\$16.8	\$16.8
Dollar Amount in Year 2020 (Million 2006 Dollars)	\$241.3	\$136.3	\$938.6	\$697.3	\$428.8	\$292.5

Appendix C

Model Results

Table C1: Reference Scenario: Total Annual Impacts in the Year 2020			
	Jobs (Actual)	Earnings (\$MM)	GDPS (\$MM)
	Total	Total	Total
Agriculture	20	\$0	\$0
Oil and Gas Mining	430	\$60	\$190
Coal Mining	-20	\$0	\$0
Natural Gas Utilities	-50	-\$10	-\$10
Construction	890	\$40	\$50
Food	10	\$0	\$0
Manufacturing	40	\$0	\$0
Oil Refining	0	\$0	\$0
Other Mining	20	\$0	\$0
Motor Vehicles	0	\$0	\$0
Wholesale Trade	50	\$10	\$10
Transportation, Communication & Utilities	-10	\$0	\$0
Services	860	\$40	\$60
Government	60	\$0	\$0
Retail Trade	210	\$10	\$20
Finance	100	\$10	\$20
Insurance/Real Estate	90	\$0	\$10
Electric Utilities	90	-\$10	-\$60
Total	2,800	\$160	\$280
Note: All dollar values are 2008 dollars.			
Results assume no in-state manufacturing of renewable energy materials.			

Table C2: 20% Clean Energy Scenario: Net Annual Impacts in 2020

	<u>Jobs (Actual)</u>		<u>Earnings (\$MM)</u>		<u>GDPS (\$MM)</u>	
	Total	Net Over Reference	Total	Net Over Reference	Total	Net Over Reference
Agriculture	110	90	\$0	\$0	\$10	\$0
Oil and Gas Mining	430	0	\$60	\$0	\$190	\$0
Coal Mining	-20	0	\$0	\$0	\$0	\$0
Natural Gas Utilities	-310	-260	-\$40	-\$30	-\$90	-\$70
Construction	2,450	1,560	\$120	\$80	\$140	\$90
Food	50	40	\$0	\$0	\$0	\$0
Manufacturing	230	190	\$20	\$20	\$30	\$30
Oil Refining	0	0	\$0	\$0	\$0	\$0
Other Mining	30	10	\$0	\$0	\$10	\$0
Motor Vehicles	0	0	\$0	\$0	\$0	\$0
Wholesale Trade	150	100	\$20	\$10	\$30	\$20
Transportation, Communication & Utilities	-140	-120	-\$10	-\$10	-\$20	-\$20
Services	2,340	1,470	\$110	\$70	\$150	\$100
Government	470	410	\$30	\$30	\$30	\$30
Retail Trade	970	750	\$40	\$30	\$70	\$60
Finance	280	170	\$20	\$10	\$50	\$30
Insurance/Real Estate	250	160	\$10	\$0	\$20	\$10
Electric Utilities	-380	-480	-\$90	-\$80	-\$330	-\$260
Total	6,890	4,100	\$310	\$140	\$300	\$20

Note: All dollar values are 2008 dollars.

Results assume no change in demand for Coal or Natural Gas, and no in-state manufacturing of renewable energy materials.

Appendix D

Scenario Development Methodology

Scenario Development

Energy Strategies⁶⁷ and SWEEP assisted with the development and review of the inputs and scenarios analyzed in this study. The assumptions for electricity sales for Utah, Utah's peak load capacity, energy available to Utah, and the operation and maintenance (O&M) costs directly follow PacifiCorp's 2007 IRP documents.^{68,69} The capacity factors and capital costs employed in this study were almost exclusively those presented by PacifiCorp in 2008 IRP planning meetings.⁷⁰ The capital costs reflect the increased commodity costs for all new resources that were experienced before the economic downturn in the fall of 2008. The costs in the IRP documents were compared to additional utility, industry, and government sources. Solar photovoltaic (PV) capital costs⁷¹ and biomass capital, O&M and fuel costs⁷² were the only resources that cite alternative sources because the renewable resource types modeled in this report were not included in the IRP documents. All of these inputs were peer-reviewed by numerous Utah and national energy stakeholders whose feedback was greatly appreciated and incorporated to the best of our ability (see Acknowledgements).

It was assumed that Utah (based on the IRP) has excess energy capacity in 2007 but will need additional capacity to meet the projected growth rates for demand. Therefore, a priority was placed on developing sufficient capacity for each scenario to meet projected demand.

It is worth noting that no coal plants were developed in either scenario because none are planned before 2020 in the 2007 IRP documents. A cost-effectiveness test was not performed in determining which resources would come online; however, the energy efficiency and renewable energy portfolios are consistent with Utah's potential and could feasibly be developed by 2020.

Highly-detailed descriptions and tables of all inputs and assumptions are available online at:
www.utahcleanenergy.org/utah-economic-development-study/appendix.

Energy Efficiency and Renewable Energy

The 20% Clean Energy Scenario was developed based on Utah's energy efficiency and renewable energy goals.⁷³

- **Energy Efficiency** - Energy efficiency assumptions for the 20% Clean Energy Scenario were adapted from the "Utah Energy Efficiency Strategy: Policy Options" report.⁷⁴ Only the savings and investments in the year 2020 were modeled in this analysis. The cost and saving assumptions for each efficiency program were used to calculate the investment and savings values used in this study. The programs analyzed are not prescriptive policy recommendations, but are quantified examples of the types of measures and associated investments that could be employed to achieve the Utah's energy efficiency goal. Detailed assumptions and spreadsheets employed to calculate the investments and savings for all energy efficiency measures modeled in this study are available online at: www.utahcleanenergy.org/utah-economic-development-study/appendix.
- **Savings**-- The dollar amounts for the energy savings are calculated by multiplying the projected energy savings in 2020 by the 2006 electricity or natural gas rate, held constant until 2020. The savings in year 2020 reflect the savings associated with all of the energy efficiency measures installed from 2007-2020, since previous years installations continue to provide energy savings into subsequent years. Only the year 2020 dollar savings are modeled, not the cumulative dollar savings from 2007-2020.
- **Investments**— Similarly, only the investments made in new energy efficiency measures in the year 2020 are modeled. This gives a snap-shot of the type of economic activity related to adopting more aggressive energy efficiency programs and policies for the state, where more investments are made each year, and savings accumulating from previous years' investments continue to pay-off. Modeling year 2020 gives a good picture of such a scenario in equilibrium, where the up-front capital investments made in earlier years deliver significant energy and dollar savings over time.
- **Wind** - The study assumes that to achieve 20 percent renewable electricity by 2020, a sizable

amount will be from wind. Since PacifiCorp is a regional utility, the 20% Clean Energy Scenario assumes that 50 percent of the wind will be developed in Wyoming, a leading and neighboring net exporter of wind energy, and 50 percent from Utah resources. The 50-50 split between Utah wind and Wyoming wind is meant to provide one possible option for the renewable energy portion of the 20% Clean Energy Scenario, but it is certainly not prescriptive. According to the 50-50 assumption, 475 MW of new Utah wind is modeled, comparable to the amount currently planned for development for export; this amount is well below the 1,830 MW of potentially developable Utah wind with greater than 30 percent capacity factor (considered to be a typical capacity factor for most commercially viable wind developments) described in the Utah Renewable Energy Zone (UREZ) Task Force Report.⁷⁵

- **Geothermal** - The study models the development of 241 MW of geothermal electricity by 2020. This is approximately equal to the 230 MW deemed to be “near-term” (ready to be developed) by the Western Governors Association Geothermal Task Force,⁷⁶ and roughly 1/3 of the estimated potential from identified geothermal systems as listed by the UREZ report (754 MW).⁷⁷
- **Solar** - The amount of solar developed was in the context of analyzing the economic development potential associated with achieving 2 percent of sales from solar power by the year 2020 (or roughly 10 percent of new renewable energy generated). This solar target is not outlined in Utah’s renewable energy goal but is being adopted in other states across the region and provided a framework for the amount of megawatts of solar developed.
 - **Concentrating Solar Power with storage (CSP)** - CSP with storage was chosen for this report because it is the most attractive technology that could be developed by 2020 due to the fact that proven storage technology extends the amount of generation available when the sun is not shining. While the potential for CSP in Utah is enormous and CSP technology is increasingly becoming more cost-competitive,

due to the relatively high cost of this technology a conservative 150 MW of CSP are analyzed in this report. This is still much less than the identified technical potential for Utah identified in the UREZ task force report - when only the highest quality sites are evaluated the potential is over 11,000 MW.⁷⁸

- **Solar Photovoltaic (PV)** - Currently Utah has about 1 MW of residential and commercial solar PV capacity are installed across the state. This study analyzes an additional 84 MW of installed capacity, much lower than Utah’s technical rooftop capacity of 5,000 megawatts by 2010.⁷⁹ The 20 percent Clean Energy scenario looks at ramping up the installation rate from 0.2 MW/year in 2007 to roughly 8 MW/year by 2020, an ambitious but achievable rate.
- **Biomass** - 23 MW of biomass capacity was developed to analyze its impacts to rural Utah.
 - **Landfill gas** - The study assumes 10 MW of landfill gas-to-electricity projects are developed. There are currently two landfill gas projects providing 4.8 MW of electricity capacity, and the 3.2 MW Trans-Jordan landfill gas project is soon to be completed. According to the U.S. EPA Landfill Methane Outreach Program, there are 5 candidate landfills with roughly 7 MW of landfill gas potential in Utah.⁸⁰
 - **Anaerobic Digesters** - The study assumes 8 MW are developed in Utah. This is primarily a rural Utah resource that relies on large quantities of animal manure to produce methane, which is then used to generate electricity.
 - **Solid Biomass (wood from urban and forest waste)** - The study assumes 5 MW are developed from prudent forest thinning, and urban wood waste.
- **Capacity Value** – The capacity value is the percentage of nameplate capacity that, for planning purposes, is relied upon to meet peak demand. For this analysis, all capacity values were used to determine the contribution to the State’s growing capacity demands of the aforementioned resources.

Traditional Resources

The new traditional resources that would have been developed between 2007-2020 are assumed to be replaced by additional new energy efficiency and renewable electricity in the 20 percent Clean Energy scenario. Simple Cycle (SC) Natural Gas plants are not planned in the 2007 IRP, but are developed in the 20% Clean Energy Scenario.

- **Combined Cycle (CC) Natural Gas** - For the Reference Scenario, CC natural gas plants are employed to meet the growing capacity and energy needs. The Reference Scenario assumes two large CC natural gas developments, one in Utah and one out of-state. The economic benefit from the total capacity of the Utah CC natural gas plants are modeled since they are built in state; but for the electricity portfolio, Utah only received its share of the capacity and energy. For the 20 % Clean Energy scenario, no additional CC natural gas plants are developed since most of the growth in capacity and energy needs from 2007-2020 are met by energy efficiency and renewable energy resources.
- **Simple Cycle (SC) Natural Gas** - No SC natural gas plants are developed in the Reference Scenario since there are none planned in the 2007 IRP. However, in the 20% Clean Energy Scenario, one 79 MW SC natural gas plant is developed to meet the coincidental peak demand needs and to balance the new renewable resources. Front Office Transactions (or Purchases) – This refers to summer time, peak load hour energy that is purchased on the market during times of high load demand. For the Reference Scenario, 1004 MW of out-of-state purchases are required by 2020. No purchases were included to meet peak demand in the 20% Clean Energy Scenario.

General Assumptions

The following assumptions were employed for this analysis:

- PacifiCorp/Rocky Mountain Power represents approximately 81 percent of Utah's electricity sales, and it is assumed that the sales and capacity requirements for entire state of Utah will follow the demand growth predicted in PacifiCorp's Integrated Resource Plan documents and presentations.

- Utah is part of a regional energy system; however, to simplify the analysis for this economic development study, all new energy and capacity were assumed to meet Utah's sales and capacity requirements.
- The only exception to the above point is that Reference Scenario attributes only Utah's share of PacifiCorp's planned energy resources to the capacity and sales demand. However, if a plant is developed in Utah, all of the economic development related to the plant (capital and O&M) will be analyzed since the construction and operation will occur in Utah, thereby creating jobs and economic development in the state.
- Scenarios are developed to meet in-state capacity demand plus 12 percent planned reserves.⁸¹
- No economic analyses were performed on any out-of-state resources or purchases.
- It was assumed that PacifiCorp (and the entire state) had excess energy in 2006,⁸² and both scenarios still have excess energy in 2020. The excess energy is from an annual average output and includes energy produced during low demand hours (e.g. energy produced overnight from existing coal plants).⁸³
- All resources are assumed to have 10 percent line (or transmission & distribution) losses. The exception to this is biomass and solar PV, since they are assumed to be smaller, distributed resources with local consumption, thereby minimizing line losses.⁸⁴
- Sensitivity analyses:
 - It is assumed that oil and natural gas drilling and coal mining in Utah will be unaffected by the 20% Clean Energy Scenario due to continued demand for oil, natural gas, and coal nationally and internationally. The impact of this assumption was modeled.
 - It is assumed that in Utah none of the renewable resource development is supplied by Utah-based manufacturing facilities. However, a

sensitivity analysis was performed to determine the potential economic impacts of having Utah-based facilities manufacturing renewable energy components for use in-state (this *does not* take into account the likelihood that in-state manufacturing facilities would supply components for both in-state and out-of-state renewable energy projects, thereby creating a new export industry for Utah). Assuming components are only used in-state for the renewable energy developments, the following percentages were used for this analysis – the percentages reflect the percent of total components needed for in-state renewable energy projects identified in the Scenarios: 50 percent of wind blades, 75 percent of wind towers, 50 percent of solar PV panels, and 0 percent of wind/gas turbines. It was assumed that existing Utah facilities could develop a significant percentage of the wind towers at our steel facilities without a dramatic re-tooling of their equipment.

