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Abstract

This document is the final technical report of the Arrowhead Center Prosper Project at New Mexico State University. The Prosper Project was a research and public policy initiative funded by the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE). The Prosper project (DOE Grant Number DE-NT0004397) began on October 1, 2008 (FY2009, Quarter 1) and ended on December 31, 2012 (FY2013, Quarter 1). All project milestones were completed on time and within the budget. This report contains a summary of ten technical reports resulting from research conducted during the project. This report also contains a detailed description of the research dissemination and outreach activities of the project including a description of the policy impacts of the project. The report also describes project activities that will be maintained after the end of the project.

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Executive Summary

The Arrowhead Center Prosper Project at New Mexico State University was a research and public policy initiative funded by the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE). The Prosper project (DOE Grant Number DE-NT0004397) began on October 1, 2008 (FY2009, Quarter 1) and ended on December 31, 2012 (FY2013, Quarter 1). All project milestones were completed on time and within the budget. This report is the final report for the Prosper project.

The PROSPER project was designed to enhance fossil fuel energy production in an environmentally progressive manner that contributes to the economic development of New Mexico to create a strong vibrant economy that better serves the needs of the people of the state. The primary motivation for the Prosper project was that New Mexico is both an energy state and a relatively poor state.

PROSPER project activities were concentrated in two main areas. First, project personnel were engaged in policy-oriented research. This research effort was directed at assessing the economic and fiscal impacts of the fossil fuel industry in New Mexico and evaluating the long term relationships between energy production and economic growth in New Mexico and other energy states. Prior to the PROSPER project, there was little or no systematic research activity focused on the complex relationships between energy production and economic development in the state. The research efforts were conducted using several different methods including the development of econometric models, the use of input-output modeling, and the application of a long-run dynamic simulation model. The public policy implications of PROSPER project research extends to other energy states. The PROSPER project research agenda resulted in the following research reports, all of which will remain available on the PROSPER project website.

- The Economic Impact of Coal Mining in New Mexico by James Peach and C. Meghan Starbuck, June 2009
- The Economic Impact of Oil and Gas Extraction in New Mexico by James Peach, Leo Delgado, and C. Meghan Starbuck, September 2009
- The Fossil Fuel Industry in New Mexico: A Comprehensive Impact Analysis by James Peach and C. Meghan Starbuck September 2009
- The Economic Impact of Coal Mining in New Mexico: 2008 Update by James Peach, June 2010
- The Economic Impact of U.S. Department of Energy Expenditures in New Mexico by Leo Delgado, Manuel Reyes, and James Peach, September 2009
- The Economic Impact of U.S. Department of Energy Expenditures in New Mexico: FY 1993-FY2009 by James Peach, Leo Delgado, and Marcella Martinez, January 2011
- Modeling Energy Market Volatility James Peach, March 2011
- Oil and Gas Production and Economic Growth In New Mexico James Peach and C. Meghan Starbuck, June 2011
- Long-Run Dynamic Impact Simulations of New Mexico's Renewable Portfolio Standard by James Peach, Scott Nystrom (REMI, Inc), and Zilin Cui (REMI, Inc.) July 2012.
- Coal Production and Regional Economic Growth by Manuel Reyes, December 2012

The second major area of the PROSPER project was outreach and the dissemination of research findings to a wide audience. Throughout the project, PROSPER project personnel sought input and

advice from various stakeholders and stakeholder groups throughout New Mexico. This input helped shape research directions and outreach activities.

Conducting research, particularly policy oriented research, without widespread dissemination of research findings has limited value. Outreach and dissemination of research findings were major activities of the PROSPER project.

As part of the outreach effort, the PROSPER project sponsored or co-sponsored four energy conferences. All of the conferences were well-attended and project personnel received very favorable reviews from conference attendees. Co-sponsoring conferences allowed the PROSPER project to leverage funds, invite nationally and internationally known energy experts as speakers, and attract attendees from several US states as well as Canada and Mexico. The conferences sponsored or co-sponsored by the PROSPER project included:

- The Energy and Economic Development Conference held March 19, 2009 in Las Cruces, NM. This conference was sponsored entirely by the PROSER project. This conference designed to bring together energy experts from around the state and nation, including former U.S. Senator Pete V. Domenici, to discuss energy and economic development. The conference show-cased initial prosper project research and provided valuable stakeholder input for future project activities.
- The Re-energize America Conference, Co-sponsored by the PROSPER project and the Institute for Energy and the Environment in the College of Engineering at New Mexico State University held in Las Cruces June, 2010. Prominent speakers included U.S. Congressman Harry Teague. Matt Rogers, Senior Advisor to Secretary of Energy for the Recovery Act gave the June 3 Keynote address. Dr. Arun Bose, NETL Program Manager for the PROSPER project provided an excellent over-view of NETL research initiatives. Conference attendance exceeded 300.
- The Reenergize the Americas Conference, October 26-27, 2011 in El Paso, Texas. The name of the conference was changed to reflect the international nature of the conference participants and attendees. The conference was jointly sponsored by NMSU's PROSPER project, NMSU's Institute for Energy and the Environment (IEE), the University of Texas at El Paso (UTEP), the Paso Del Norte Group (PDNG), and the Texas General Land Office. Hunter L. Hunt of Hunt Oil provided an excellent keynote address.
- The Reenergize the Americas conference (RTA) was held October 17 and 18, 2012 at the Las Cruces, NM Convention Center. As with the 2011 RTA conference, co-sponsors of the 2012 conference included the NMSU PROSPER Project and the Institute for Energy and the Environment at New Mexico State University, the University of Texas at El Paso (UTEP), and the Paso del Norte Group. In addition to the three main sponsors, substantial external funding contributed to the success of the conference. Registered attendance at the conference was 253.

PROSPER project personnel made numerous formal presentations at academic and non-academic conferences that were not funded by the project. In addition, the project's principal investigator, James Peach, presented briefings and testimony to New Mexico legislative committees and other policy-makers. The PROSPER project also maintained a website as a means of disseminating information about the project to the public and stakeholders.

Some highlights and indications of the success of the PROSPER project cannot be quantified in terms of numbers of research reports, conferences sponsored, presentations to various stakeholder groups. The PROSPER project was above all a policy initiative designed to encourage economic development in New Mexico by linking careful analysis of the fossil fuel industry and related policy issues in an environmentally conscious fashion. One indication that the PROSPER project has made a difference is that the Economic and Rural Development Committee of the New Mexico legislature endorsed a draft of a Senate Memorial at its November 4, 2011 meeting encouraging the New Mexico Economic Development Department to pursue an energy-based economic development strategy. Another indication was the enthusiastic response to an energy based economic development strategy from New Mexico Economic Development Department Secretary, Jon Barela.

Finally, an unintended but very positive consequence of the PROSPER project was that several graduate research assistants gained valuable analytical skills and knowledge of the energy industry. It is likely that most of the graduate research assistants will have a long-term interest and professional involvement in energy and economic development.

SECTION I: INTRODUCTION

The Arrowhead Center PROSPER Project at New Mexico State University was a research and public policy initiative funded by the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE). The PROSPER project (DOE Grant Number DE-NT0004397) began on October 1, 2008 (FY2009, Quarter 1) and ended on December 31, 2012 (FY2013, Quarter 1). This report is the final report for the PROSPER project.

The PROSPER project was designed to enhance fossil fuel energy production in an environmentally progressive manner that contributes to the economic development of New Mexico to create a strong vibrant economy that better serves the needs of the people of the state. The primary motivation for the PROSPER project was that New Mexico is both an energy state and a relatively poor state –themes that are discussed below.

When the PROSPER project began, there was little or no systematic research on the relationship between fossil fuel energy production and the process of economic development in New Mexico. Public policy discussions concerning this relationship were infrequent and were often based on misconceptions or limited information about energy and economic development in the state. The PROSPER project began the systematic research process necessary to understand the energy-economic development relationship in New Mexico. Although the research conducted was focused on New Mexico, the research findings also have implications for energy policy in other states. Dissemination of Prosper project research findings and numerous outreach activities generated useful policy discussions in the state. Although the project has come to an end, the need for additional research and meaningful policy discussions continues.

Background: New Mexico as an energy state

New Mexico is involved in nearly all aspects of the energy industry, an industry that is one of the state's most important and dynamic economic sectors. The fossil fuel sector is particularly important in New Mexico. In 2011, New Mexico ranked 6th in the nation in crude oil production, 7th in natural gas production, and 13th in coal production (Energy Information Administration, State Profiles, 2012).

Crude oil production in New Mexico has increased dramatically in recent years, from 60 million barrels per year in 2008 to 84 million barrels per year in 2012 –an increase of 40.3 percent in a five year period. The increase in oil production in the state has paralleled the national increases in production associated with relatively high oil prices, shale oil production, and new drilling technology.

In contrast to recent trends in crude oil production, New Mexico's production of natural gas has been decreasing in recent years. In the early 2000's, New Mexico produced 1.6 trillion cubic feet of natural gas per year, but that figure has decreased to 1.2 trillion cubic feet in 2012. While the state has ample reserves of natural gas, production has been falling because of low natural gas prices associated with the national increase in natural gas discoveries, particularly in shale formations. Indeed, active natural gas wells in the state fell from more than 40,000 in 2008 to 32,000 in 2011.

New Mexico produced more than 21 million tons of coal in 2011, but coal production has been decreasing in recent years (25 million tons in 2007). Coal still accounts for 2/3 of electricity

generation in New Mexico (68.1 percent in 2011) but this figure is down from 80 percent in the early 2000s. The downward trend in coal production in New Mexico is a result of stricter environmental regulations and a rapidly changing mix of fuel types for electricity generation in the New Mexico and the nation.

Employment in the fossil fuel industry in New Mexico is a relatively small portion of total non-farm employment but the average wage per job is very high compared to other private sector employment. For example, in 2011 employment in Oil and Gas Extraction (NAICS code 2111) was 4,795 jobs or about 0.8 percent of total private sector employment (596,921) but the average wage per job in this sector ($88,653) was more than twice the average for all private sector jobs ($38,674) (Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2012). The fossil fuel industry also generates a disproportionate share of state tax revenue. Taxes on oil and gas production typically amount to 15 or 20 percent of total state revenue.

New Mexico's fossil fuel industries are not limited to extraction. In 2012, there are two active refineries with an operating capacity of 142,000 barrels per day and numerous oil and gas pipelines contribute to the state economy as well.

While New Mexico has no nuclear generation facilities, the state has vast uranium reserves, a large uranium processing plant, a radioactive storage facility, and research laboratories that are heavily involved in nuclear research. New Mexico was once the world's largest producer of uranium but has produced no significant amount of uranium since the early 1980s. In 2012, uranium mining companies began seeking federal, state, and local permits for both exploration and mining activities in the state. Substantial uranium mining operations in New Mexico could begin in 2013 or 2014.

New Mexico is one of 31 states that have Renewable Portfolio Standards (RPS) requiring a percentage of retail electricity sales to be generated from renewable energy sources. In 2011, wind 6.1 percent) and solar (0.9%) electricity generation account for nearly all of New Mexico's renewable generation under the RPS standards (Energy Information Administration, Electricity Annual). There is currently no geothermal electricity generation in the state but a 10 megawatt geothermal plant is scheduled to start production in 2013. Renewable generation capacity has been growing rapidly and will continue to do so over the next several years.

While nearly all of New Mexico's 33 counties have active energy sectors, the geographic distribution of energy activity is concentrated in the state. Eight counties produce oil and gas and coal production is limited to a single county. The employment and income generated from energy industry activities are also geographically concentrated.

Background: New Mexico as a poor state.

Despite its significant energy industry, New Mexico remains a relatively poor state. In 2011, 21.5 percent of New Mexico's population was below the poverty level. Only Mississippi had a higher poverty rate in 2011 (22.6 percent) (U.S. Bureau of the Census, American Community Survey, http://www.census.gov/prod/2012pubs/acsbr11-01.pdf). A similar percentage of the state's population (21.8 percent) received SNAP (Supplemental Nutrition Assistance Program) benefits in Fiscal Year 2012 (U.S. Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/snapmain.htm).

New Mexico's economy was not immune to the effects of the national recession that began in December, 2007. The New Mexico economy turned down a few months after the nation and by 2009 the state lost nearly 50,000 non-farm payroll jobs –about 6 percent of total jobs. In late 2012, there were few signs of recovery from the recession in New Mexico. Unlike most states, especially states in the western part of the nation, there is simply no upward trend in employment. The most recent recession was not, however, the cause of New Mexico's lack of economic progress. For several decades, New Mexico's per capita income has been about 20 percent lower than the national average (Bureau of Economic Analysis, Regional Data, www.bea.gov, 2012).

Since the end of World War II, the New Mexico economy has been dominated by two main industries: energy production and government expenditures, particularly federal government expenditures. In Fiscal Year 2010, the latest year for which complete data are available, federal government expenditures in New Mexico were $27.8 billion or nearly 1/3 of state Gross Domestic Product (U.S. Bureau of the Census, Consolidated Federal Funds Report, FY2010). Federal expenditures are not offset by what New Mexicans pay in federal taxes. In a typical year, New Mexicans pay federal taxes equal to about ¼ of federal expenditures in the state.

It is likely that New Mexico's future economic growth will also depend heavily on the energy industry and government expenditures. Current economic conditions and the political debate over federal deficits do not suggest that New Mexico should rely on growth in government as an engine for state economic growth. In this context, New Mexico's energy industry will become even more important to the future of the state economy than it already is.

Research and analysis linking the energy industry and state economic development are useful in shaping future development policy in New Mexico and other energy states. The research and other activities of the PROSPER project were a meaningful contribution to the energy-based economic development of New Mexico.

The research activities of the PROSPER project are detailed in Section II. The outreach and research dissemination activities of the project are detailed in Section III. A financial summary is presented in Section IV.

SECTION II: RESEARCH

The research activities of the PROSPER project were focused on two major themes. First, a series of technical reports (described in detail below) were designed to assess the economic impact of the fossil fuel industry in New Mexico. This research included economic impact analysis of oil and gas production, coal mining, and a report on the comprehensive impacts of fossil fuels in the state. The comprehensive impact report included analysis of fossil-fuel related industries such as refining and pipeline transportation that were not included in the previous reports on extractive industries.

Each economic impact report included the effects of the industry on employment, income, and value added in the state. In addition, each impact report assessed the tax revenue impact to the state of New Mexico. The economic impact reports combined with the importance of the fossil fuel industry to state tax revenues motivated additional research on the effects of energy price volatility and peak oil. Additional impact studies of the impact of U.S. Department of Energy expenditures in New Mexico were also prepared. The methods used in the impact reports as well as a summary of results appear in the descriptions of each report.

A second major theme of PROSPER project research was focused on the long-run dynamic relationships between fossil fuel production and economic growth. Technical reports were prepared on the long run effects of oil and gas production and coal production on economic growth in the context of the resource curse hypothesis. The resource curse hypothesis suggests an inverse relationship between economic growth and resource extraction activities. Most of the empirical work on the resource curse hypothesis has been conducted using nations as the unit of analysis. The analysis in the PROSPER project reports on this topic was based on county level data. In contrast to most of the research in this area, our research found that fossil fuel production had small but positive impacts on long run economic growth at the county level as measured by income, employment, and population change.

The research findings from the PROSPER project have important policy implications in New Mexico and other energy states. For example, PROSPER research indicated that energy production and related activities have a larger impact on state tax revenue than is generally assumed. Without a fossil fuel industry, other taxes in the state (e.g., income taxes, property taxes, and gross receipts taxes) would need to be higher –resulting in possible detrimental effects on state economic growth. Second, the long run dynamic economic effects of fossil fuel and other energy activities are generally positive at the state and county levels. This finding suggests that energy related activities should be encouraged by state policy to stimulate economic growth. During the course of the project it became apparent that officials in both the legislative and executive branches of government were receptive to the idea of an energy based strategy of economic development in New Mexico.

A summary of each PROSPER project research report follows. Complete copies of each report are available on the PROSPER project website: http://arrowheadcenter.nmsu.edu/prosper-project

● The Economic Impact of Coal Mining in New Mexico by James Peach and C. Meghan Starbuck, June 2009

Summary: This report provides an analysis of the impact on the New Mexico economy of coal mining in 2007. This report is one of a series of reports on the impact of fossil fuels in New Mexico.

New Mexico has been producing coal for more than a century. By 1918 New Mexico coal production reached four million short tons but declined to a low of 123,000 tons in 1954. New Mexico coal production began to rise again in the early 1960s, but did not reach its 1918 production level of four million short tons until 1969. More than half of all coal mined in the state has been produced since 1990. Between 1882 and 2007, New Mexico produced 936.7 million short tons of coal. From 1990 to 2007, New Mexico produced 480.7 million short tons of coal (51.3 percent of all coal mined ever mined in the state).

The US contains 27 percent of the world's recoverable reserves of coal (Energy Information Administration 2009). New Mexico has an estimated 483 million short tons of economically recoverable coal, which represents 2.6 percent of the total estimated US coal reserves in 2007. The majority of the coal resources in New Mexico are in the San Juan Basin (SJB) which contains large areas of alternating sandstone and shale beds. The basin contains two main coal bearing deposits, the Fruitland and the Mesa Verde.

In 2007 New Mexico's four active coal mines produced 24.4 million short tons of coal. The average price of New Mexico's coal in 2007 was $27.69 per short ton. The value of coal produced in New Mexico in 2007 was $673.9 million. In 2007, New Mexico had four active coal mines (1 underground mine and 3 surface mines). New Mexico coal production has remained relatively stable in the early years of the 21st century –with production averaging about 25 million short tons and with the price of a short ton between $25 and $30.

During the last several decades, the number of active coal mines in New Mexico has steadily decreased, while production from the remaining active mines has increased dramatically. In 1952 there were 27 active coal mines in the state with a total production of 759 thousand short tons of coal (U.S. Bureau of Mines 1952). The decrease in the number of active mines and the simultaneous increase in production during the last half century reflect a shift from underground mining to surface mining in the state.

The direct, indirect, and induced effects of coal mining in New Mexico were assessed using an input-output model embedded in IMPLAN software. In 2007 the coal mining industry in New Mexico contributed $1.039 billion in output (direct, indirect and induced) to the state economy. Value added was $588 million. Direct employment in coal mining in New Mexico was 1,390 jobs. Total employment (direct, indirect, and induced) associated with coal mining was 3,293 jobs. The coal mining industry accounted for $83.5 million in state revenue in 2007. The results are summarized in Table 1 below.

Table 1 (Direct, Indirect, and induced impacts of coal mining in New Mexico: 2007

Value	Direct	Indirect	Induced	Total
Output	$673,944,832	$200,289,241	$165,636,748	$1,039,870,811
Value Added	$370,295,392	$97,019,908	$91,238,499	$588,553,819
Employment	1,390	786	1,117	3,293
Labor Income	$141,941,298	$41,541,286	$35,149,868	$218,632,452

●The Economic Impact of Coal Mining in New Mexico: 2008 Update by James Peach (June 2010)
Summary: This report provides an analysis of the impact of coal mining on the New Mexico economy in 2008. This report is an update of an earlier report (*The Economic Impact of Coal Mining in New Mexico*, June 2009). All data and impacts have been updated through calendar year 2008. In addition, the analysis was conducted using a major update to the economic modeling software (IMPLAN Pro Version 3.0).

New Mexico has been producing coal for more than a century. In 1918 New Mexico coal production reached four million short tons, but declined to a low of 123,000 short tons in 1954. New Mexico coal production began to rise again in the early 1960s, but did not reach its 1918 production level of four million short tons until 1969. More than half of all coal mined in the state has been produced since 1990. Between 1882 and 2008, New Mexico produced 962.3 million short tons of coal. From 1990 to 2008, the state produced 506.4 million short tons of coal (52.6 percent of all coal ever mined in the state).

In 2008, New Mexico's coal mines produced 24.1 million short tons of coal. The average price was $29.91 per short ton (average of FY2008 and FY2009 data reported by the State Board of Finance). The reported sales value of coal produced in New Mexico in 2008 was $727.3 million.

The coal mining industry in New Mexico contributed about $1.0 billion in total output and $553 million in value added –including the direct, indirect and induced effects. Direct coal mining employment in New Mexico in 2008 was 1,445 jobs. Total employment (direct, indirect, and induced) associated with coal mining employment was 3,068. In total, the industry accounted for $106 million in tax, rental, and royalty income to the state. These impacts changed little from 2007 because both coal production and coal prices were relatively stable in 2007 and 2008. These impacts are summarized in Table 1A.

Table 1A. Coal Mining Impacts in New Mexico 2008.

	Direct	Indirect	Induced	Total
Output	$727,520,526	$126,355,696	$160,257,856	$1,014,134,080
Value Added	$393,783,000	$67,023,960	$93,127,370	$553,934,300
Employment	1,445	541	1,082	3,068
Labor Income	$141,007,616	$27,791,852	$34,525,080	$203,324,544

●The Economic Impact of Oil and Gas Extraction in New Mexico James Peach, Leo Delgado, and C. Meghan Starbuck September 2009)

Summary: In 2007, New Mexico had an estimated 3.4% of US crude oil reserves (735 million barrels); 7.3% of the US reserves of dry natural gas (17.245 trillion cubic feet); and 9.2% of the nation's reserve of natural gas liquids (844 million barrels). New Mexico is also home to significant coal reserves, with an estimated 483 million short tons of recoverable coal in 2007 (EIA State Energy Profiles).

Crude oil production in New Mexico represented 2.9% of the US total supply in February 2009 with 4.517 million barrels produced, and annual oil production in New Mexico was 59.403 million barrels in 2008. Natural gas production in New Mexico was 7.7% of the US supply in 2007 with a total of 1.544 trillion cubic feet (EIA State Energy Profiles). New Mexico has three crude oil refineries: Navajo Refining (Artesia, NM); Western Refining SW Inc. (Bloomfield, NM); and Western Refining SW Inc. (Gallup,NM). The total refining capacity in the state is 132,600 barrels per calendar day as of January 2009. This refining capacity is 0.8% of the US total. New Mexico has numerous major pipelines for crude oil, petroleum product, liquefied natural gases, and interstate natural gas pipelines, and the Blanco Hub for natural gas (EIA State Energy Profiles).

New Mexico consumes an average of 352 million BTU per capita (2006) which ranks New Mexico 21st in the nation for energy use. In 2006 EIA estimated that New Mexico consumed 683 trillion BTUs, compared with the 2,650 trillion BTUs of energy production for that year, making New Mexico a net energy exporter. New Mexico has a total population of 1,984,356 which is 0.65% of the US population, but produced 3.7% of the nation's energy in 2006 (EIA State Energy Profiles, US Census Quick Facts).

The direct employment of 15,904 in the oil and gas industry generates $1.2 billion in labor income, which is equivalent to $77,653 per job. The total employment associated with the industry (direct, indirect, and induced employment impacts) is 41,718 jobs, which was 5.1 percent of New Mexico's total private sector employment in 2008.

The oil and gas industry also contribute important revenues to the State General Fund. The largest sources of oil and gas revenue are from Federal Minerals Leasing ($564.2 million in FY 2008), the oil and gas school tax ($557.8 million in FY 2008), and State Land Office Royalties ($459.9 million in FY 2008). Payments from these three revenue sources generated more than $1.58 billion dollars for the General Fund in 2008. The total direct state revenues associated with the oil and gas industry was more than $1.86 billion in FY2008. Indirect revenues associated with the industry generated an additional $191 million dollars for New Mexicans.

●The Fossil Fuel Industry in New Mexico: A Comprehensive Impact Analysis: James Peach and C. Meghan Starbuck September 2009

Summary: This report provides a comprehensive analysis of the impact on the New Mexico economy of fossil fuel industries in 2008. This report is one of a series of reports on the impact of fossil fuels in New Mexico.

Two fossil fuel industries dominate the state's energy sector. These industries are (1) oil and gas extraction and (2) coal mining. Previous reports (Peach, Delgado and Starbuck 2009, Peach and Starbuck 2009) examined the economic impact of these two industries in New Mexico and updated conclusions from these reports are incorporated in this report. Fossil fuel related industries analyzed in this report but not covered in the previous reports are: (1) fossil fuel fired electrical generation, (2) natural gas distribution and pipeline distribution of natural gas, (3) oil refining, and (4) retail gasoline distribution. Due to lack of adequate data, pipeline transportation of crude oil and ethanol processing are not included.

For each industry listed, this report contains a brief description of the industry and economic impacts for the most recent year for which data are available (generally 2008). The impacts presented include estimates of value added, employment, labor income, and state fiscal impacts.

Direct, indirect, induced and total impact effects are presented for value added, employment and labor income. Direct effects are the result of economic activity in the sector under consideration. Direct effects can be calculated using industry output, value added or employment. Indirect effects represent changes in inter-industry purchases as they respond to the new demands of the directly affected industries. Indirect effects reflect the interdependence of industries. Induced effects reflect changes in spending from households as income increases or decreases due to the changes in production. The total effect is simply the sum of the direct, indirect and induced effects.
The value added, employment and labor income impacts were calculated using IMPLAN PRO version 2.0 software. IMPLAN (Pro Version 2.0) is economic modeling software developed by the Minnesota IMPLAN Group (http://implan.com) to conduct economic impact analysis. The IMPLAN model is based on the national input-output model produced by the U.S. Department of Commerce, Bureau of Economic Analysis.

State fiscal impacts were calculated using effective tax rates as a percent of labor income calibrated to the most recent data available.

Major findings of the analysis follow:

- In 2008, New Mexico's fossil fuel energy sectors produced $11.9 billion in direct value added or 14.9 percent of state GDP. Accounting for the indirect and induced effects, New Mexico's fossil fuel energy sectors contributed $16.0 billion in value added or 20.1 percent of state GDP.

- Direct employment in the fossil fuel energy sectors accounted for 27,809 jobs or 3.4 percent of total jobs in the state. Of the direct jobs in fossil fuel industries, 15,904 or 57.2 percent were in the oil and gas extraction sector. Total jobs including indirect and induced employment generated by fossil fuel energy sectors were 65,164 or 7.9 percent of the state total.

- Direct employment in fossil fuel energy industries resulted in $1.9 billion in labor income or 5.0 percent of the state total.

- The fossil fuel industries accounted for $1.5 billion in direct revenue to the state or 25.7 percent of state revenues in 2008.

- Additional indirect taxes totaled $250.1 million from direct economic activity and a total of $424.4 million in taxes from indirect economic activity.

- The total revenue impact from fossil fuels was $1.9 billion or 33.2 percent of state revenue.

●The Economic Impact of U.S. Department of Energy Expenditures in New Mexico: Leo Delgado, Manuel Reyes, and James Peach, (September 2009)

Summary: This report provides an analysis of the impact of U.S. Department of Energy expenditures in New Mexico from 1993 to 2008. Federal Expenditures have been an important component of the New Mexico economy for many years. Total Federal Spending in New Mexico for FY 2008 was $23.8 billion (US Census Bureau, 2008) or 29.8 percent of New Mexico's 2008 GDP of $79.9 billion. U. S. Department of Energy (DOE) expenditures of $4.87 billion represented 20.4 percent of total federal expenditures in the state and 6.1 percent of the state's 2008 GDP.

Among the many DOE activities in New Mexico, expenditures associated with Los Alamos National Laboratory (LANL) and Sandia National Laboratory (SNL) accounted for about 67 percent of DOE expenditures in the state in FY 2007. LANL and SNL had budgets of $1.8 and $1.5 (in billions) respectively. (Department of Energy, 2008).

Direct, indirect, induced and total impact effects are presented for value added, employment and labor income. State fiscal impacts were calculated using effective tax rates as a percent of labor income.

Estimates from earlier studies of the impact of DOE expenditures in New Mexico are summarized in the report.

Major findings of the report are as follow:

- Federal expenditures in New Mexico totaled $23.85 billion and constitute an important part of the New Mexico economy with GDP of $79.9 billion.
- DOE expenditures of $4.85 billion accounted for 20.3 percent of all federal expenditures in the state.
- DOE expenditures generated $5.0 billion in direct value added and $7.3 billion in total value added.
- DOE Expenditures generated 37,051 direct jobs and 60,154 total jobs in the state.
- Labor income per worker in direct jobs was $89,768 –more than twice the state average.
- DOE expenditures generated $578.5 million in state tax revenue.

●The Economic Impact of U.S. Department of Energy Expenditures in New Mexico: FY 1993-FY2009 James Peach, Leo Delgado, and Marcella Martinez, (January 2011)

Summary: This report provides an analysis of the impact of U.S. Department of Energy expenditures in New Mexico from 1993 to 2009. This report is an update of an earlier technical report prepared as part of New Mexico State University's Arrowhead Center's PROSPER project funded by U.S. Department of Energy Grant Award Number DE-NT0004397.

Federal expenditures have been an important component of the New Mexico economy for many years. Total federal spending in New Mexico for FY 2009 was $27.5 billion (U.S. Census Bureau, 2009) or 36.7 percent of New Mexico's 2009 GDP of $74.8 billion. U. S. Department of Energy (DOE) expenditures of $5.7 billion represented 20.8 percent of total federal expenditures in the state and 7.6 percent of the state's 2009 GDP.

Among the many DOE activities in New Mexico, expenditures associated with Los Alamos National Laboratory (LANL) and Sandia National Laboratory (SNL) accounted for about 56 percent of DOE expenditures in the state in FY 2009. LANL and SNL had budgets of $1.9 and $1.3 (in billions) respectively (Department of Energy, 2010).

Direct, indirect, induced and total impact effects are presented for value added, employment and labor income. State fiscal impacts were calculated using effective tax rates as a percent of labor income.

Estimates from earlier studies of the impact of DOE expenditures in New Mexico are summarized in the report.

Major findings of the report are as follows:

- Federal expenditures in New Mexico totaled $27.5 billion and constitute an important part of the New Mexico economy with GDP of $74.8 billion.
- DOE expenditures of $5.71 billion accounted for 20.8 percent of all federal expenditures in the state.
- DOE expenditures generated $3.9 billion in direct value added and $5.4 billion in total value added.
- DOE Expenditures generated 39,850 direct jobs and 64,698 total jobs in the state.
- Labor income per worker in direct jobs was $89,761 –more than twice the state average.
- DOE expenditures generated $591.3 million in state tax revenue.

●Modeling Energy Market Volatility James Peach, (March 2011)

Summary: Energy market volatility (EMV) –including changes in price, employment, and output—affects U.S. macroeconomic conditions and disproportionately affects economic activity in energy states. Policy simulations and forecasting exercises based on national or regional economic models can be misleading unless energy market volatility is explicitly incorporated in the models. The basic question addressed in the paper is: what would happen to policy simulations if energy market variability in the current decade (2010 to 2019) was similar to the pattern of the previous decade (2000 to 2009)?

Three approaches to this question were examined using REMI PI+ ™ models of the national economy and the state of New Mexico. Experiment 1 imposed historic patterns of volatility directly in simulations of the next time period of the same length. Experiment 2 involved selecting a random pattern of variability using the mean and standard deviation from the previous decade. Experiment 3 was a Monte Carlo approach involving 250 replications of Experiment 2 and constructing interval estimates of key economic variables. In all cases only one energy sector, employment in oil and gas extraction was considered. All changes were made to the REMI national model and the effects were recorded from both the national and New Mexico models.

The simulations resulted in economically significant changes in total employment and Real GDP at both the state and national levels. These differences occurred in simulations with a relatively short

(ten year) time horizon. Dynamic forecasting and policy simulation exercises produce substantially different outcomes when EMV is taken into account explicitly than in standard model specifications.

●Oil and Gas Production and Economic Growth in New Mexico James Peach and C. Meghan Starbuck, (June 2011).

The central question addressed in this paper is whether or not New Mexico's counties are subject to the resource curse, a phenomenon documented frequently in the literature. Natural resource abundance was once commonly assumed to be a distinct advantage in the process of economic growth. During the 1950s and 1960s, economists noticed an inverse relationship between economic growth and resource abundance. How, they asked, could you explain the relatively high incomes of resource poor areas such as Israel, Switzerland, or Japan and the relatively low incomes of resource rich areas such as West Virginia or Mexico? What began as a simple observation that resource abundance did not necessarily provide the basis for income growth was later formalized as the 'resource curse hypothesis."

Most of the empirical studies of the resource curse hypothesis have used national or state level data and a broad definition of natural resources. In contrast, this analysis uses county level data with a focus on oil and gas extraction. The relationship between oil and gas production and economic growth in New Mexico will be analyzed using cross section data for the state's 33 counties in Census years 1960, 1970, 1980, 1990, and 2000. The model is also estimated for 2000 only using a larger sample of 925 counties in the 13 states that produce more than 90 percent of the nation's oil and gas. New Mexico is an energy state (Snead 2009). In 2008, New Mexico's marketed value of oil and gas was $19.2 billion or 24.0 percent of the state's GDP (Peach and Starbuck, 2009). Natural gas accounted for slightly more than two-thirds (67.1 percent) of total market value. Crude oil and marketed natural gas production in 2008 for the leading energy states are presented in Table 1. New Mexico was the fourth largest producer of marketed natural gas in the US and accounted for 7.8 percent of total production. New Mexico's 59.4 million barrels of oil production in 2008 accounted for 4.3 percent of total US production and the state ranked seventh among oil producing states. Eight counties currently produce oil and gas in New Mexico.

Revenue received from fossil fuels and related industries (refineries, pipeline transportation, electricity generation from coal, etc) in New Mexico accounted for 33.4 percent of all state revenue in 2008. Oil and natural gas extraction is by far the most important fossil fuel industry in the state. Oil and gas extraction accounted for 23.8 percent of state revenue, 10.1 percent of private sector employment, and 14.9 percent of state GDP (Peach and Starbuck, 2009).

In this report, an econometric model was designed and estimated to test the resource curse hypothesis. The econometric model was based on economic growth models at the regional level and modified to incorporate oil and gas production. The model was estimated for 1960, 1970, 1980, and 1990 both for New Mexico counties and for an extended sample of 913 counties in states that account for nearly 90 percent of US crude oil production.

In contrast to much of the resource curse literature, the estimated models suggest that oil and gas extraction in New Mexico Counties has had a small but positive effect on income, employment and population. Similar results were obtained when the model was estimated for 925 counties in 13 energy producing states for the year 2000.

One reason why the results presented here differ from those in most resource curse studies is that the current study was narrowly focused on oil and gas production, while the usual practice has been to examine a broadly defined natural resource variable. A second explanation of the differences in this and other studies is the unit of analysis. Most resource curse models are conducted using national level data, while the models estimated here were based on county level data.

A revised version of the PROSPER project technical report "Oil and Gas Production and Economic Growth in New Mexico" was published as a refereed journal article in June 2011. The complete citation is:

James Peach and C. Meghan Starbuck, "Oil and Gas Production and Economic Growth in New Mexico" *Journal of Economic Issues*, Vol. XLV, No. 2 (June 2011), pp. 511-526. This is the first PROSPER project technical report to be published as a journal article.

● Long-Run Dynamic Impact Simulations of New Mexico's Renewable Portfolio Standard: James Peach, Scott Nystrom (REMI, Inc), and Zilin Cui (REMI, Inc.) July 2012.

Summary: The focus of the analysis in this report is on how New Mexico's Renewable Portfolio Standards (RPS), if fully implemented will affect New Mexico's economy and the state's fossil fuel industry. The New Mexico RPS requires 20 percent of retail sales of electricity in the state to be generated by renewables by the year 2020. New Mexico currently produces more than 90 percent of its electricity from fossil fuels –mainly coal and natural gas. RPS policies currently exist in 31 states and the District of Columbia. Five additional states have voluntary renewable portfolio standards. The economic effects of RPS, including impacts on fossil fuel industries, are likely to vary considerably from state-to-state because of differences in the standards, differences in economic structure, and differences in existing generation capacity.

The analysis for New Mexico is based on long-run dynamic simulations of the economy using the REMI PI+ ™ model. Several scenarios were considered. The New Mexico results suggest that the positive effects of increased capital expenditures in the state required to comply with the renewable requirements dominate the negative effects of price increases required to pay for the additional renewable capacity. None of the scenarios, however, indicated that the required capital costs of compliance could be achieved without exceeding the Reasonable Cost Thresholds (RCT) required by statute and regulatory rulings. An unanticipated result of the simulations was that the long-run impact on New Mexico's RPS on the state's oil fuel industries (coal and natural gas extraction, in particular) was minimal.

●Coal Production and Regional Economic Growth Manuel Reyes (December 2012)

Summary: This report provides an analysis of the impact of coal production on economic growth in twenty-six coal producing states.

The natural resource curse hypothesis suggests that abundant natural resource endowment has a negative impact on economic growth. This study assesses the natural resource curse hypothesis exploring coal production and its impact on economic growth in coal producing states in the US. The impact of coal production on economic growth is measured using three different variables: income,

employment and population. A cross section analysis is conducted for the twenty-six coal producing states using county level data between 2000 and 2009. The use of oil and gas production measures, human capital and demographic variables as controls variables complement the analysis.

This report builds on a previous technical report prepared for the PROSPER project, "Oil and Gas Production and Economic Growth in New Mexico". That report estimated the economic impact of oil and gas production on economic growth in New Mexico, where 925 counties in thirteen states were assessed. This report estimates the economic impact of coal production in 1,925 counties. As a coal producing state, economic growth in New Mexico is also assessed in the study.

The major findings of this report are: a positive and significant relationship between coal production and income; a negative and significant relationship between coal production variability and economic growth; and a positive and significant relationship between fossil fuel production (oil, gas, and coal) and economic growth.

SECTION III: OUTREACH AND DISSEMINATION OF RESEARCH FINDINGS

Throughout the project, PROSPER project personnel sought input and advice from various stakeholders and stakeholder groups throughout New Mexico. This input helped shape research directions and outreach activities.

Conducting research, particularly policy oriented research, without widespread dissemination of research findings has limited value. Outreach and dissemination of research findings were major activities of the PROSPER project.

As part of the outreach effort, the PROSPER project sponsored or co-sponsored four energy conferences. All of the conferences were well-attended and project personnel received very favorable reviews from conference attendees. Co-sponsoring conferences allowed the PROSPER project to leverage funds, invite nationally and internationally known energy experts as speakers, and attract attendees from several US states as well as Canada and Mexico.

PROSPER project personnel made numerous formal presentations at academic and non-academic conferences that were not funded by the project. In addition, the project's principal investigator, James Peach, presented briefings and testimony to New Mexico legislative committees and other policy-makers.

The PROSPER project also maintained a website as a means of disseminating information about the project to the public and stakeholders.

The outreach and research dissemination activities of the project are described in detail below.

Conferences sponsored or co-sponsored:

●Energy and Economic Development Conference: March 19, 2009

The PROSPER project held its first conference (Energy and Economic Development) on March 19, 2009 on the New Mexico State University (NMSU) campus. The conference was well-attended (78 attendees at the opening session out of 90 who had registered for the conference). NETL Project Manager, Arun Bose, also attended. After introductions by project principal investigator Jim Peach, there were additional welcoming remarks by NMSU Interim President, Waded Cruzado, NMSU Vice-President for Economic Research and former Governor of New Mexico Garrey Carruthers. Among the speakers were Former US Senator Pete V. Domenici, Dr. Thomas Clifford, Research Director of the New Mexico Tax Research Institute, James Manatt, Jr., President of Providence Technologies (an oil technology company), Daniel Fine of New Mexico Tech University, and Leo Delgado, a policy analyst at Arrowhead Center.

The conference provided valuable input for project planning for years 2 and 3. Important issues addressed included future prospects for the fossil fuel industry in the state, the effects of energy price volatility on both the industry and state revenues, the regulatory environment including New Mexico's pit rules, the potential effects of cap and trade legislation on the state's energy economy, oil and gas reserves, and production trends in the state. The conference concluded with an open discussion of issues facing New Mexico's fossil fuel industry over the next several years.

●Re-energize America Conference, Co-sponsored by the PROSPER project and the Institute for Energy and the Environment in the College of Engineering at New Mexico State University June 2010.

The conference was held at the New Mexico Farm and Ranch Heritage Museum near the New Mexico State University (NMSU) Campus on June 3 and 4, 2010. PROSPER Project personnel were heavily involved in the planning and operation of the conference.

The conference's purpose was to: "give attendees the opportunity to actively engage leaders in government, industry and academia about issues key to America's energy future. This conversation went beyond policy discussions with a distinct focus on how participants can develop a short-term plan for long-term sustainability (quote from the conference website: http://energize.nmsu.edu/) ." The conference attracted more than 300 participants. Feedback from a conference evaluation survey indicated that those attending found the conference to be informative and stimulating.

U.S. Congressman Harry Teague and New Mexico State University President Dr. Barbara Couture served as Honorary Co-Chairs of the Conference. The Co-chairs actively participated in conference events. Matt Rogers, Senior Advisor to Secretary of Energy for the Recovery Act gave the June 3 Keynote address. U.S. Senator Jeff Bingaman (Chair of the Energy and Natural Resources Committee) was scheduled to appear but a last minute family emergency prevented him from doing so. Other speakers included Fred Mondragon, Secretary of the New Mexico Department of Economic Development, Jon Goldstein - Secretary, New Mexico Energy, Minerals, and Natural Resources Department, and representatives from both Los Alamos National Laboratory and Sandia National Laboratory. Dr. Arun Bose, NETL Program Manager for the PROSPER project provided an excellent over-view of NETL research initiatives.

●Reenergize the Americas Conference, October 26-27, 2011 in El Paso, Texas

The PROSPER project co-sponsored the third annual Re-energize the Americas Conference (RTA) held October 26 and 27, 2011 at the El Paso Convention Center. The conference was jointly sponsored by NMSU's PROSPER project, NMSU's Institute for Energy and the Environment (IEE), the University of Texas at El Paso (UTEP), the Paso Del Norte Group (PDNG), and the Texas General Land Office. PDNG is a private non-profit group promoting economic development in the Paso del Norte region (including southern New Mexico).

The keynote speakers were Hunter L. Hunt, CEO of Hunt Consolidated Energy, and Colonel Joseph Simonelli, Jr., Garrison Commander at Ft. Bliss, TX). President Barbara Couture of New Mexico State University and President Diana Natalicio of the University of Texas at El Paso provided their insights on university collaboration with both government agencies and the private sector in conducting energy research. A PROSPER project booth at the conference disseminated brochures about the project, responded to questions, and displayed technical reports. There were approximately 250 attendees at the conference.

●Reenergize the Americas Conference, October 17 and 18, 2012 in Las Cruces, NM

The Reenergize the Americas conference (RTA) was held October 17 and 18, 2012 at the Las Cruces, NM Convention Center. As with the 2011 RTA conference, co-sponsors of the 2012 conference included the NMSU PROSPER Project and the Institute for Energy and the Environment at New Mexico State University, the University of Texas at El Paso (UTEP), and the Paso del Norte Group. In

addition to the three main sponsors, substantial external funding contributed to the success of the conference. Registered attendance at the conference was 253.

The PROSPER project was a co-sponsor of the conference and project personnel were actively engaged in the planning and operations of the conference. Planning meetings for the conference were scheduled on a weekly basis and electronic communications regarding the conference occurred almost daily. The conference website is: http://reenergizetheamericas.com/

The theme of the 2012 conference was Energy and Economic Development. This theme reflected the goals and purposes of the NMSU PROSPER Project. The 2012 conference, as well as previous conferences, was designed to encourage energy-related economic development in New Mexico and surrounding regions by providing a forum for informed discussion of energy technology and policy issues. The program is available at the conference website: http://reenergizetheamericas.com/.

The keynote speaker (October 17) was Julie Dill (President and CEO of Spectra Energy Partners). Dill has thirty years of experience in the energy industry and was previously President of Union Gas, the nation's largest natural gas distributor. Dill's keynote address was focused on the future of the natural gas industry and included analysis of the opportunities created by recent discoveries. Dill also addressed the regulatory environment and challenges faced by the industry related to security issues. The address was well –received. A luncheon keynote was delivered by Richard V. Kidd IV (Deputy Assistant Secretary of the Army for Energy and Sustainability). Kidd's address was focused on innovative energy programs underway by the Department of Defense. Other speakers include Alberto Chretin, Secretary of the Economy, for the State of Chihuahua, Mexico and Jon Barela, Secretary of the New Mexico Economic Development Department.

The breakout sessions were well-attended. A complete listing is included in the RTA conference program (attached to this report as Appendix I). NMSU PROSPER Project personnel were involved throughout the conference, but the session titled "Regional Energy Policy Issues" was particularly important. The session was chaired by Garrey Carruthers, Dean of the College of Business at New Mexico State University and former Governor of New Mexico. Speakers included Jon Barela, Secretary of the New Mexico Economic Development Department; Duncan Wood, from the Instituto Tecnológico Autónomo de Mexico and the Woodrow Wilson Institute; and Jim Peach, NMSU PROSPER project principal investigator. Presentations and discussion in this well-attended session were focused on the interaction of state and regional energy policy and technology. These issues have been a major part of the PROSPER Project.

Presentations and Testimony

This section details conference presentations, testimony at legislative hearings, and other presentations made by PROSPER project personnel at events not sponsored by the project.

●November 11, 2008. PROSPER project principal investigator (Peach) attended a meeting of the Roswell Geological Society (RGS) held in Artesia, New Mexico, November 11, 2008. For fifty years, the Roswell Geological Society has been the leading place for New Mexico petroleum geologists to meet and share information. In addition to geologists, the meetings often attract business executives in the energy industry and other interested parties. At the November 2008 meeting, there were approximately 30-35 attendees. Peach was offered the opportunity to explain the PROSPER project and did so. The project description was received with considerable enthusiasm and there were several offers of help from experienced and well-informed oil and gas industry personnel. These valuable contacts were used throughout the project.

●November 20, 2008. James Peach presented a seminar describing the PROSPER project at NETL headquarters in Pittsburgh. This was a productive meeting to establish communication about the project with NETL staff, including project Director, Dr. Arun Bose, and others. This meeting clearly paved the way for open and direct communication throughout the project and led to a clearer understanding and better definition of the scope of the project. The abstract of the seminar presentation was as follows:

New Mexico has large reserves of crude oil, coal, and natural gas. Current estimates place the fossil fuel reserves of New Mexico, as a percent of the United States total, at approximately: crude oil (3.4%), dry natural gas (8.5%), liquid natural gas (10.2%), and coal (2.7%). The natural abundance of fossil fuel resources in New Mexico and the lack of dense population in the areas where these resources occur provide significant potential for economic development in the State while supplying to the energy markets in the U.S. The Arrowhead Center of the New Mexico State University to Promote Prosperity and Public Welfare (PROSPER) will conduct research analyzing the relationships between the fossil fuel energy sector and economic development issues in New Mexico. This project is a research and policy initiative effort to enhance fossil fuel energy production and use in New Mexico in an environmentally responsible manner that contributes to the economic development of the State. The project will actively engage stakeholders in the research process and will provide a timely, in-depth, cutting-edge economic analysis of the issues that are identified as critical in the development and utilization of New Mexico's fossil fuels and aid New Mexico in delivering the energy the Nation needs.

●May 2009. Participation and attendance at the New Mexico Town Hall titled "Growing New Mexico's Energy Economy" held in Albuquerque, New Mexico in May 2009. PROSPER project personnel contributed to the New Mexico First Energy Report and participated in the Town Hall. For the PROSPER project many useful contacts in New Mexico energy industries and in the public policy arena were established or re-enforced. Prosper project principal investigator (Peach) has been appointed to the research review board for the energy report for New Mexico First (http://www.nmfirst.org/), a non-profit, non-partisan public policy group founded in 1986 by New Mexico Senators Pete V. Domenici (now former senator) and Jeff Bingaman. New Mexico First addresses key issues facing the state with a bi-annual town meeting focused on a single topic. For each town-hall topic, New Mexico First prepares a detailed factual report. Consensus policy recommendations are a major result of the town-hall meetings. The topic for the next town hall to be

held in Albuquerque in mid May 2009 is "How to Grow the New Mexico Energy Economy." This activity is not directly supported by project funds but will provide many additional stakeholder contacts with individuals in the energy industry, state government, and citizen groups. PROSPER project researchers also will attend the energy town-hall in May.

●June 2009. PROSPER project personnel (Peach and Delgado) attended the "Solving New Mexico's Energy Problems Today" conference sponsored by New Mexico Tech University in Hobbs, New Mexico. As with the New Mexico First Conference, many useful contacts for the PROSPER project were made or enhanced. Congressman Harry Teague (D-NM) gave the introductory remarks. U.S. Senator Jeff Bingaman gave the keynote address. Both Congressman Teague and Senator Bingaman expressed interest in and support for the PROSPER project. All of these activities have resulted in valuable input to the planning for years 2 and 3 of the project.

●August 31, 2009. Re-Energize America Conference sponsored by New Mexico State University. Details of the conference are available at http://energize.nmsu.edu/. This conference was not sponsored by the PROSPER project, but Principal Investigator (James Peach) made a presentation at the conference titled: "How do we move to a homegrown energy economy?" The focus of this presentation was on the history of US energy policy and the need for a national energy plan.
The conference was an impressive event –highlighted by a presentation from U.S. Department of Energy Secretary Stephen Chu. The intense interest of New Mexicans regarding energy issues was reflected by conference attendance of well over 500. The conference also resulted in numerous new contacts of energy stakeholders for the Prosper project.

●October 15, 2009. James Peach made a presentation of the research findings on modeling peak oil at the annual REMI model user's conference in Portland, Oregon (October 13-15, 2009). Conference attendees included regional economists, revenue forecasters, and energy analysts from several states. The presentation was well-received. Few conference attendees were aware of the peak oil assumption built into the REMI forecasting model.

●December 11, 2009. James Peach and C. Meghan Starbuck attended the NETL Peer Review Session in Pittsburgh, PA. The presentation for the PROSPER project was made by Meghan Starbuck. The peer review process was informative and resulted in suggestions for minor modifications to the project in years 2 and 3. The recommendations included: (1) strengthening the project team by consulting with NMSU engineering faculty, (2) Identify ways to maximize profit from fossil fuel activities, (3) determine how the project can benefit other states and the entire nation, and (4) increase public outreach by broadening the mediums through which information is communicated. Processes to implement all four suggestions were either under-way prior to the review or were adopted in subsequent years.

●March 12, 2010. Analysis of the relationship between oil and gas production and economic growth of New Mexico Counties was presented to the College of Business (New Mexico State University) Research Seminar Series on March 12, 2010. The seminar series is an opportunity for NMSU faculty to present their recent research and to receive feedback from other researchers. The comments received during the seminar were very positive and constructive. Some minor changes were made to the paper as a result of those comments.

●April 16, 2010. James Peach presented "Oil and Gas Production and Economic Growth in New Mexico" at the 52nd annual meetings of the Western Social Science Association (WSSA) in Reno,

Nevada in April, 2010. WSSA is a highly respected, multi-disciplinary organization of academics and professionals dedicated to the advancement of the social sciences. Additional information about the WSSA may be found at its website (http://wssa.asu.edu/). The paper was well received and some useful suggestions were made by the discussants. After some minor changes and editing, this paper was submitted as a technical report. The revised version of the report was also published in the *Journal of Economic Issues*.

●October 4, 2010. James Peach made a presentation titled: "Modeling Energy Market Volatility" at the 25th Annual REMI Modeling Conference held in Austin, Texas (October 3-4, 2010). The study was motivated by the volatility in state revenues and economic activity associated with variation in energy prices, employment, and output. The analysis was based on various simulations of the REMI dynamic simulation model for New Mexico. While the analysis is specific to New Mexico, the simulations have policy implications for many other energy states. A technical report based on this analysis was submitted.

●May 17, 2011. Mikidadu Mohammed, a graduate research assistant with the PROSPER project, presented preliminary analysis of water-energy relationships in New Mexico at a conference titled: Sustainability on the Border: Water, Climate and Social Change in a Fragile Landscape. The conference was held on the University of Texas El Paso (UTEP) campus May 16-18, 2011 and was sponsored by the Center for Environmental Resource Management at UTEP. PROSPER project personnel have received very positive comments from Mr. Mohammed's presentation.

●June 27, 2011. James Peach presented a webinar (web based seminar) for users of the REMI economic simulation model. Economists, policy analysts and other model users from around the nation were able to view the seminar on their own computers and to listen to the presentation on a call-in phone number. REMI, Inc. regularly schedules webinars on a variety of topics. The topics for this presentation combined two PROSPER project research topics: Peak Oil and Energy Market Volatility. The emphasis in the presentation was how to model energy markets in an era of uncertainty and volatility in prices, production, and employment. The power-point presentation is posted to the PROSPER project Website. Usually, there are 30 or 40 participants in REMI webinars. There were 130 participants in the June 27 event. Mark D'mato, a senior economist at Regional Economic Models, Inc. stated that this webinar was "one of the most successful webinars we have had. Over 130 people registered and we have received a lot of very positive feedback from participants (email from Mark D'amato, July 20, 2011)." The benefit to the PROSPER project from conducting the webinar is direct. There are now well-over 100 additional professionals who are aware of the PROSPER project and its research efforts.

●August 8, 2011. James Peach made a presentation to the Rural and Economic Development Committee of the New Mexico Legislature on August 8, 2011 in Santa Rosa New Mexico. The topic of the presentation was "An Energy Sector Strategy for Economic Development in New Mexico." The presentation was based mainly on PROSPER project research during the previous three years on the relationship of fossil fuel production and economic growth in the state. The Committee members were interested in economic development strategies that had the potential to affect all New Mexico counties, particularly rural counties that had often been neglected in state-led economic development efforts.

Peach told the committee that an energy based economic development strategy had the potential to reach all counties in the state. In particular: (1) the energy industry has a long history in the state and

that history provides New Mexico with a competitive advantage, (2) for the most part, the energy industry in New Mexico is an export-base industry, (3) the energy sector is a high wage sector with large employment and income multipliers, (4) New Mexico has abundant coal, natural gas, oil, uranium, geothermal resources, and wind potential, and (5) the energy sector is closely linked to the state's scientific and engineering facilities. As a result of this meeting, a memorial (SJM 20) was introduced in the 2012 New Mexico legislative session encouraging the New Mexico Economic Development Department to pursue an energy-based economic development strategy.

The PROSPER project was above all a policy initiative designed to encourage economic development in New Mexico by linking careful analysis of the fossil fuel industry and related policy issues in an environmentally conscious fashion. Providing convincing evidence of the project's influence on policy at the state level is a challenging task. One indication that the PROSPER project has made a difference is that the Economic and Rural Development Committee of the New Mexico legislature endorsed a draft of a Senate Memorial at its November 4, 2011 meeting encouraging the New Mexico Economic Development Department to pursue an energy-based economic development strategy. The memorial will be considered during the regular sessions of the New Mexico legislature in January 2012.

●September 21, 2011 James Peach briefed New Mexico Economic Development Department (NMEDD) Secretary, Jon Barela, on an economic development strategy based on energy. The briefing took place at NMEDD headquarters in Santa Fe, NM. The briefing was similar to the presentation made to the Rural and Economic Development Committee (above). Secretary Barela was enthusiastic concerning the prospects for using the state's energy resources as a basis for economic development. Secretary Barela described himself as "on-board" for such a strategy.

●April 11-14, 2012. Two PROSPER project research papers were presented at the 54th Annual Meetings of the Western Social Science Association in Houston, TX (April 11-14, 2012). The two presentations were: (1) James Peach, "Long Run Dynamic Simulations of New Mexico's Renewable Portfolio Standards" and (2) Manuel Reyes-Loya, "Coal Production and Economic Growth at the County Level". Academic presentations such as these provide additional exposure to PROSPER project research efforts and provide valuable review and feedback. Both presentations were well-received at the conference but minor revisions were suggested. Technical reports based on the two presentations are now being revised. Publication of these reports in refereed journals will also be pursued. A revised version of the Renewable Portfolio Standards analysis will be presented nationally at a webinar in July.

●July 16, 2012. A revised version of the PROSPER project Renewable Portfolio Standards analysis was presented nationally at a webinar on July 16, 2012 by Principal Investigator James Peach and Scott Nystrom from REMI, Inc. who co-authored the study. The webinar was sponsored by REMI, Inc. and attracted more than a 100 participants nation-wide. The analysis is described in detail in a soon to be submitted technical report. A particular focus of the analysis was on the implications of New Mexico's RPS on the fossil fuel industry. An unanticipated result of the simulations was that the long-run impact on New Mexico's RPS on the state's oil fuel industries (coal and natural gas extraction, in particular) was minimal.

● September 26, 2012. James Peach presented a combination of two PROSPER project research efforts titled: Modeling Peak Oil and Energy Market Volatility to the 22nd Annual Mexican Colloquium on Mathematical Economics and Econometrics. The presentation was held on the University of Texas

at El Paso campus with a simultaneous TV broadcast to the Universdad Autonomo de Ciudad Juarez. The audience consisted mainly of academics from both sides of the border.

Website Development:

In early 2009, a PROSPER project website was established to inform the public about project research and activities. The website contained announcements of PROSPER project conferences, electronic copies of technical reports, and links to other energy related websites. Project personnel received numerous positive comments about the website. The website will be maintained and updated as long as possible after the end of the project on December 31, 2012. Technical reports and additional energy analyses will still be available to the public. The website is maintained on the Arrowhead Center servers. The address of the website is: http://arrowheadcenter.nmsu.edu/prosper-project.

The website as of early 2013 is displayed below:

ARROWHEAD CENTER

RESOURCES | INTELLECTUAL PROPERTY | BUSINESS PARK | INNOVATION NETWORK | GET INVOLV

Resources

- Enterprise Research
- Technology Incubation
- Policy Analysis
- PROSPER

Support Programs

- Innoventure
- NME Alliance
- Studio G

PROSPER Project

The Arrowhead Center Prosper Project at New Mexico State University was a research and public policy initiative funded by the National Energy Technology Laboratory (NETL) of the U.S. Department of Energy (DOE).

The Prosper project (DOE Grant Number DE-NT0004397) began on October 1, 2008 (FY2009, Quarter 1) and ended on December 31, 2012 (FY2013, Quarter 1). Arrowhead Center will continue to maintain the Project website for an indefinite period.

When the PROSPER project began, there was no systematic research on the relationship between fossil fuel energy production and the process of economic development in New Mexico. The PROSPER project began the systematic research process necessary to understand the energy-economic development relationship in New Mexico. Although the research conducted was focused on New Mexico, the research findings also have implications for energy policy in other states.

Dissemination of Prosper project research findings and numerous outreach activities were an important part of the project. Technical reports prepared during the course of the project are available below.

For additional information, contact: James Peach (jpeach@nmsu.edu) or 575-646-3113.

Technical Reports

- The Economic Impact of Coal Mining in New Mexico
- The Economic Impact of Coal Mining in New Mexico: 2008 Update
- The Fossil Fuel Industry in New Mexico: A Comprehensive Impact Analysis
- The Economic Impact of U.S. Department of Energy Expenditures in New Mexico: FY 1993 -FY2009
- Modeling Energy Market Volatility
- The Economic Impact of Oil and Gas Extraction in New Mexico
- Oil and Gas Production and Economic Growth In New Mexico
- Coal Production and Regional Economic Growth
- Modeling Energy Market Volatility

Presentations

- Modeling Energy Market Volatility Using REMI October 2010
- Peak Oil and REMI PI+: State Fiscal Implications

U.S. Department of Energy

- Office of Fossil Energy
- National Energy Technology Laboratory
- Energy Information Administration

Other Energy Links

- New Mexico Energy, Minerals and Natural Resources Department
- Re-energize America Conference

Financial Summary

A summary of planned and actual costs of the PROSPER project by fiscal year appears in the following table. The total cost of the project was $1.2 million including cost share of $238,000. Two no-cost time extensions for fiscal years FY2010 and Quarter 1 of FY2013 were approved for the project. These no-cost time extensions allowed the project to conduct additional research and outreach activities. Quarterly progress reports submitted throughout the project contain additional cost data.

PROSPER Project Cost Plan Status: FY2009 to FY2013 Qtr 1 (End of Project)*

Baseline Reporting Quarter	Year 1	Year 2	Year 3	Year 4	YEAR 5 QTR 1
	FY2009	FY2010	FY2011	FY2012	FY2013
Baseline Cost Plan (From SF-424A)					
Federal Share	$ 300,187.65	$ 317,701.27	$ 327,051.08	$ 233,832.62	$ 32,943.61
Non-Federal Share	$ 110,884.46	$ 61,749.04	$ 63,601.51	$ 4,831.12	$ 4,831.12
Total Planned (Federal and Non-Federal)	$ 411,072.11	$ 379,450.30	$ 390,652.59	$ 238,663.74	$ 37,774.73
Cumulative Baseline Cost	$ 411,072.11	$ 790,522.41	$ 1,181,175.00	$ 1,181,175.00	$ 1,181,175.00
Actual Incurred Costs					
Federal Share	$ 245,859.43	$ 259,861.46	$ 205,386.49	$ 200,889.01	$ 32,943.61
Non-Federal Share	$ 132,410.20	$ 62,598.12	$ 36,395.56	$ -	$ 4,831.16
Total Actual Incurred Costs (Federal and Non-Federal)	$ 378,269.63	$ 322,459.58	$ 241,782.05	$ 200,889.01	$ 37,774.77
Cumulative Incurred Costs	$ 378,269.63	$ 700,729.21	$ 942,511.26	$ 1,143,400.27	$ 1,181,175.04
Variance					
Federal Share	$ 54,328.22	$ 57,839.81	$ 121,664.59	$ 32,943.61	$ 0.00
Non-Federal Share	$ (21,525.74)	$ (849.08)	$ 27,205.95	$ 4,831.12	$ (0.04)
Total Variance-Quarterly Planned (Federal and Non-Federal)	$ 32,802.48	$ 56,990.72	$ 148,870.54	$ 37,774.73	$ (0.04)
Cumulative Variance	$ 32,802.48	$ 89,793.20	$ 238,663.74	$ 37,774.73	$ (0.04)

*The Prosper Project was initially funded for three years (FY2009 through FY2011).
No cost extensions extended the project through FY2012 and FY2013 Qtr 1.

About Arrowhead Center

Arrowhead Center was created by New Mexico State University (NMSU) to be an engine for sustainable economic development, ultimately improving the quality of life for all New Mexicans. Arrowhead Center is accomplishing this by collaboratively facilitating the creation of an innovation-driven economy, where New Mexico's ability to convert ideas into marketable technologies, faster and better than the competition, will determine the pace of the state's economic growth.

Generating ideas in bulk and leaving commercialization to chance is not sufficient to spur innovation. To accelerate our innovation economy, Arrowhead Center brokers the constant interplay between those in the market in search of solutions, innovative researchers, savvy entrepreneurs, eager students, educated employees, advanced facilities, and effective public/private partnerships. We are equipped to leverage innovation as an ongoing mechanism for promoting new business development and the job growth that goes with it.

Arrowhead Center serves as a single portal to link the researchers and entrepreneurs with ideas for how to solve market problems and take advantage of market opportunities that will keep New Mexico on the leading edge of discovery and sustainable economic growth. We help researchers turn scientific discovery into intellectual property. We offer services to enable entrepreneurs to turn these new, researcher developed technologies into viable businesses. We manage a 200-plus acre state-of-the-art Business and Research Park for these new technology start-ups to locate amongst other established businesses driven by the discovery of new knowledge and technologies. These businesses in turn hire well-educated employees in high-paying positions.

NMSU is laying the foundation for discovery and innovation in fields ranging from unmanned aircraft systems to alternative energy, and through our state network of universities and national laboratories, Arrowhead Center is connected to some of the best ideas and practices emerging in laboratories and markets throughout the Nation.
We aim to grow new technology companies, retain and expand the ones we have, attract still others from elsewhere, forge actionable alliances, broaden partnerships, and provide systematic, continuous and adequate assistance to the actors of our innovation economy. We hope you join us in our mission.

Board of Directors of Arrowhead Center (As of February 2013)

The Arrowhead Center's Board of Directors is comprised of leaders from New Mexico State University and at-large members from across New Mexico. Each Director was selected for their expertise, insight, and experience critical to the mission and strategic direction of the Arrowhead Center.

Tilahun Adera, Ph.D., Dean, College of Health and Social Services, New Mexico State University
Jon Barela, Secretary, New Mexico Economic Development Department.
Kevin Boberg, Ph.D., Director and Chief Executive Officer (CEO) of Arrowhead Center, New Mexico State University
Garrey Carruthers, Ph.D., NMSU Dean, College of Business & Vice President for Economic Development, New Mexico State University
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Javier Gonzales, New Mexico State University Regent
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Ricardo Jacquez, Ph.D., Dean, College of Engineering, New Mexico State University
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Bruce Kite, New Mexico State University General Counsel (Ex-Officio)
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