

# **Getting Beyond the Hype: A Critical Review of the Economic Impacts of the Proposed Roca Honda Uranium Mine**

A report prepared for the  
**Multicultural Alliance for a Safe Environment (MASE)**

By

**Thomas Michael Power  
Donovan S. Power**

**Power Consulting, Inc.  
Missoula, Montana  
[www.powereconconsulting.com](http://www.powereconconsulting.com)**

April 11, 2014

**About the Authors:**

**Thomas Michael Power** is the Principal in Power Consulting, Inc. and a Research Professor and Professor Emeritus in the Economics Department at The University of Montana where he has been a researcher, teacher, and administrator for over 40 years. He received his undergraduate degree in Physics from Lehigh University and his MA and PhD in Economics from Princeton University.

**Donovan S. Power** received his undergraduate degree in Geosciences at the University of Montana and his M.S. in Geology from the University of Washington. He has been the principal scientist at Power Consulting, Inc. for the past six years.

# Getting Beyond the Hype: A Critical Review of the Economic Impacts of the Roca Honda Uranium Mine

## Executive Summary

Roca Honda Resources LLC has proposed a uranium development project that would involve a mine in the vicinity of the city of Grants, New Mexico. The uranium mine would make use of Cibola National Forest land and Roca Honda Resources has submitted a mining proposal to the U.S. Forest Service for approval.

Power Consulting, Inc. was asked by the Multicultural Alliance for a Safe Environment (MASE) to review the economic impacts that the proponents of the proposed Roca Honda Mine have claimed will result if that mine is built and operated. Those claimed impacts, as described by the mine's proponents, are exclusively positive, including new employment, wages and salaries, and revenues to state and local governments that would be directly and indirectly associated with the proposed Roca Honda Mine.

We emphasize that we will be focused on analyzing the reality of those claimed positive economic impacts. Economics, as a social science, typically emphasizes both benefits *and costs*. In that context, "economic impacts" would refer to both positive *and negative* impacts. However, "economic impact analysis" typically does *not* follow standard economic practice. Instead it provides a proponent's one-sided view emphasizing only benefits and ignoring any costs. In that sense "economic impact analysis" has come to refer to a type of public relations effort designed to help the proponent of a particular project that has public impacts or costs to emphasize the positive aspects of a project in order to garner public support for their project. This is understandable and useful to the companies seeking to increase the likelihood that their proposed project will be approved. It has the drawback, however, of ignoring the public costs that are almost always associated with large industrial projects. That focus on positive impacts (benefits) while ignoring any negative impacts (costs) assures a relatively one-sided presentation that really cannot be accurately labeled an *economic* impact analysis since only part of the economic impacts, the positive ones, are included in the analysis.

This report stays within the context of that narrower and always positive economic impact analysis that is produced primarily to promote the mine. We focus on whether the claimed positive economic impacts associated with the proposed mine are accurately stated. In addition it is important for those claimed positive impacts to be placed within the context of a relatively volatile uranium market and how the local

economy will experience those impacts. It is only in those contexts that the relative importance of the claimed positive impacts can be evaluated.

The analysis in the main body of this report supports that following conclusions:

**1. The positive economic impacts directly associated with the proposed Roca Honda Mine will be quite modest.**

The direct employment associated with the operation of the proposed mine will be between 220 and 253 jobs depending on which Roca Honda Resource projection is used. The total number of jobs in McKinley and Cibola Counties in 2012 was about 41,000. The direct mine employment would add less than one percent to those existing jobs. The pay associated with these mining jobs, however, would be well above average, as high as \$75,000 per year.

**2. Because the region around the proposed mine is largely rural, the *ripple* or *multiplier* impacts associated with proposed mine will be relatively small.**

The “ripple” effects associated with the purchases made by the mining company to operate the proposed mine as well as the ripple effects associated with new workers associated with the operation of the mine spending their paychecks will tend to flow rather quickly out of the two-county study area to larger trade centers in New Mexico and the nation.

As a result, for every 10 direct mining jobs or direct mining payroll dollars, only about three additional jobs or dollars of labor income will result due to ripple or multiplier impacts. This puts the total additional jobs associated with the proposed mine in the 340 to 375 job range. The total increase in labor income would be in the \$17 to \$22 million per year range.

If we look at regional jobs and income creation between the uranium bust in 1983 and the onset of the Great Recession in 2008, McKinley and Cibola Counties were able to add, on average, 790 more jobs each year, 19,000 jobs in total over that 25-year period. The total jobs and payroll associated with the Roca Honda Mine including the ripple effects represent about 6 months of normal job and real income growth during that period.

**3. The positive economic impacts estimated based Roca Honda Resources' information, however, were much higher than these estimated economic impacts, as much as eleven times higher.**

The Cibola National Forest's Draft Environmental Impact Statement estimated that the total employment impact of the operation of the proposed mine would be 1,184 jobs and the total payroll would be \$190 million. Roca Honda Resources presented even larger positive total economic impacts associated with the operation of the proposed mine: 4,123 jobs and \$241 million in labor income.

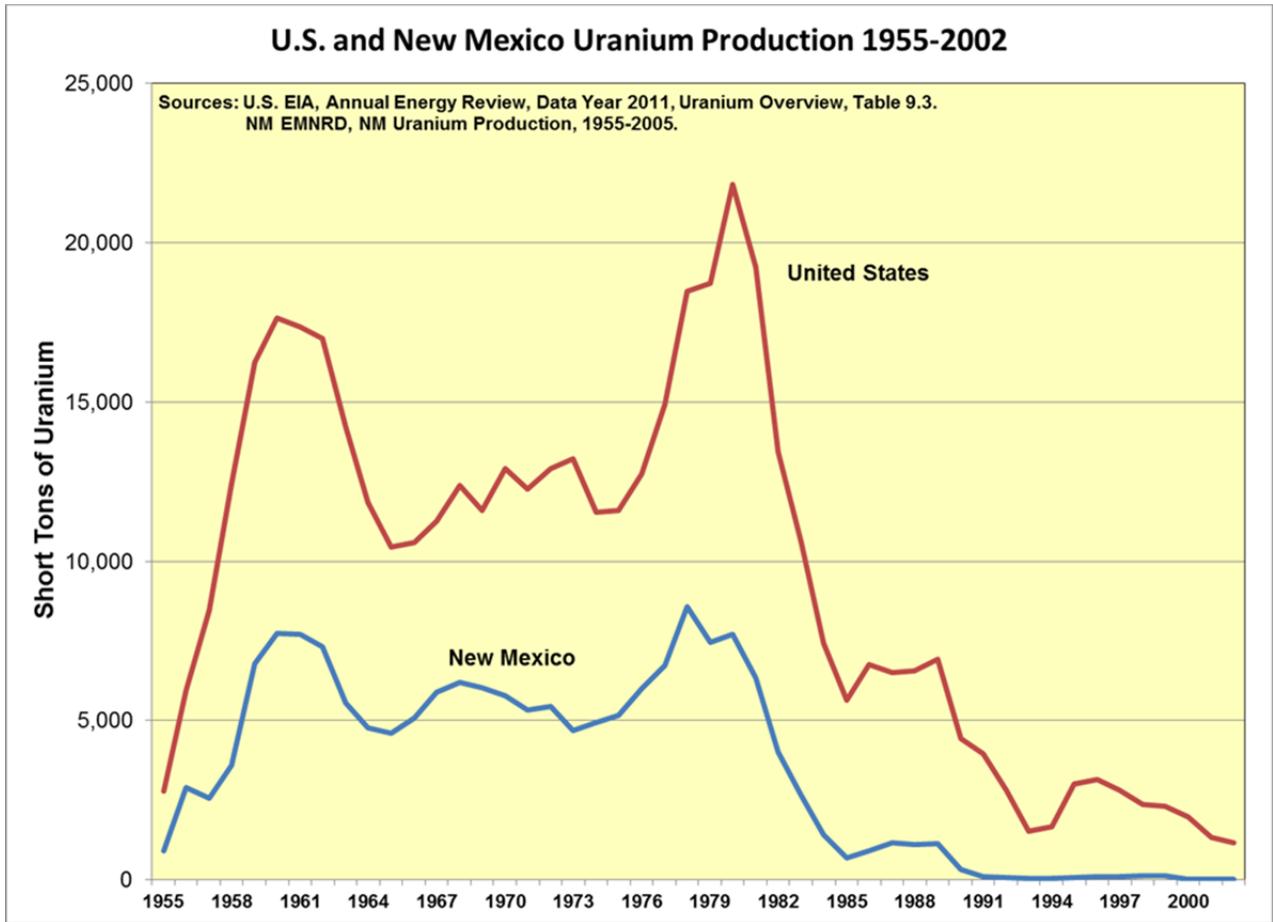
**4. These projected very large positive economic impacts associated with the proposed Roca Honda Mine are the result of those impacts being stated as the average number of jobs or the average annual pay of those additional workers multiplied by the life of the mine. That is *not* how employment or payroll is measured.**

Employment is measured on an annual basis as are payroll and income. When new jobs are created, they are not reported as the number of jobs multiplied by how long the jobs are expected to last. If they were, the jobs associated with ongoing businesses, schools, and government agencies would be multiplied by 30, 50, 100 or more years. Each working person would be multiplied by his or her expected working life. Individuals' incomes would be reported as all of the income they were expected to receive over their entire lives. Adopting such an approach to measuring jobs and income would generate very big numbers that tell us nothing useful. Given that the purpose of economic impact analysis *is* to generate very large positive numbers in support of any and all proposed projects, it is not surprising that most economic impact analyses do exactly that.

**5. The uranium market is rarely stable. Uranium prices fluctuate widely and when they do uranium production also fluctuates. This triggers wide swings in uranium employment, payroll, and payments to governments since all of these positive impacts are associated with the level of uranium production.**

New Mexico has had a long history with this instability in uranium mining and milling as well as similar instability in copper mining and smelting. Figure ES-1 shows the fluctuation in uranium production in New Mexico and the United States.

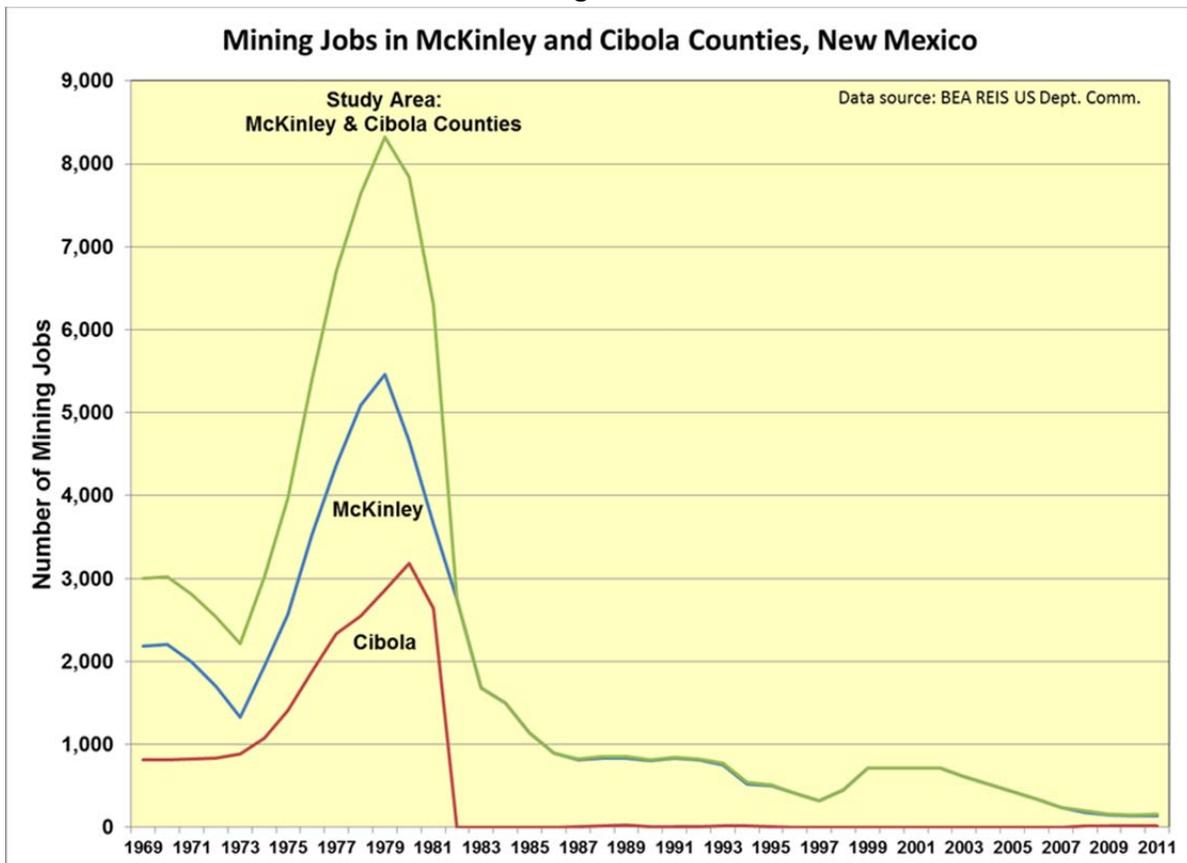
Figure ES-1.



The impact of these fluctuations on uranium production in McKinley and Cibola Counties was also dramatic. Figure ES-2 shows the fluctuation in mining employment in those two counties between 1969 and 2011.<sup>1</sup> Uranium payroll and payments to governments fluctuated in a similar fashion.

<sup>1</sup> Employment data by industry is not readily available at the county level before 1969.

Figure ES-2.



**6. Uranium prices have continued to fluctuate widely over the 2004-2013 decade. Each time uranium prices rose, uranium industry analysts have jumped to the conclusion that those high prices were “here to stay” and that a New Mexico uranium renaissance was at hand. Those expectations of high and stable uranium prices have not been realized.**

Figure ES-3 shows the recent fluctuations in uranium prices. There were price spikes in 2007-2008 as well as 2011. Those price increases were short-lived. But, at the time, uranium industry analysts projected that uranium prices would stay at \$90 or \$75 per pound indefinitely into the future. Instead, uranium prices have trended downward. As a result the majority stockholder in the proposed Roca Honda Mine, Energy Fuels, has shut down or plans to shut down all of its existing uranium mines and the uranium mill it owns. This provides a reminder of the inherent instability in uranium mining and processing.

Figure ES-3.

**Market Price of Uranium: Spot and Long-Term Contract**



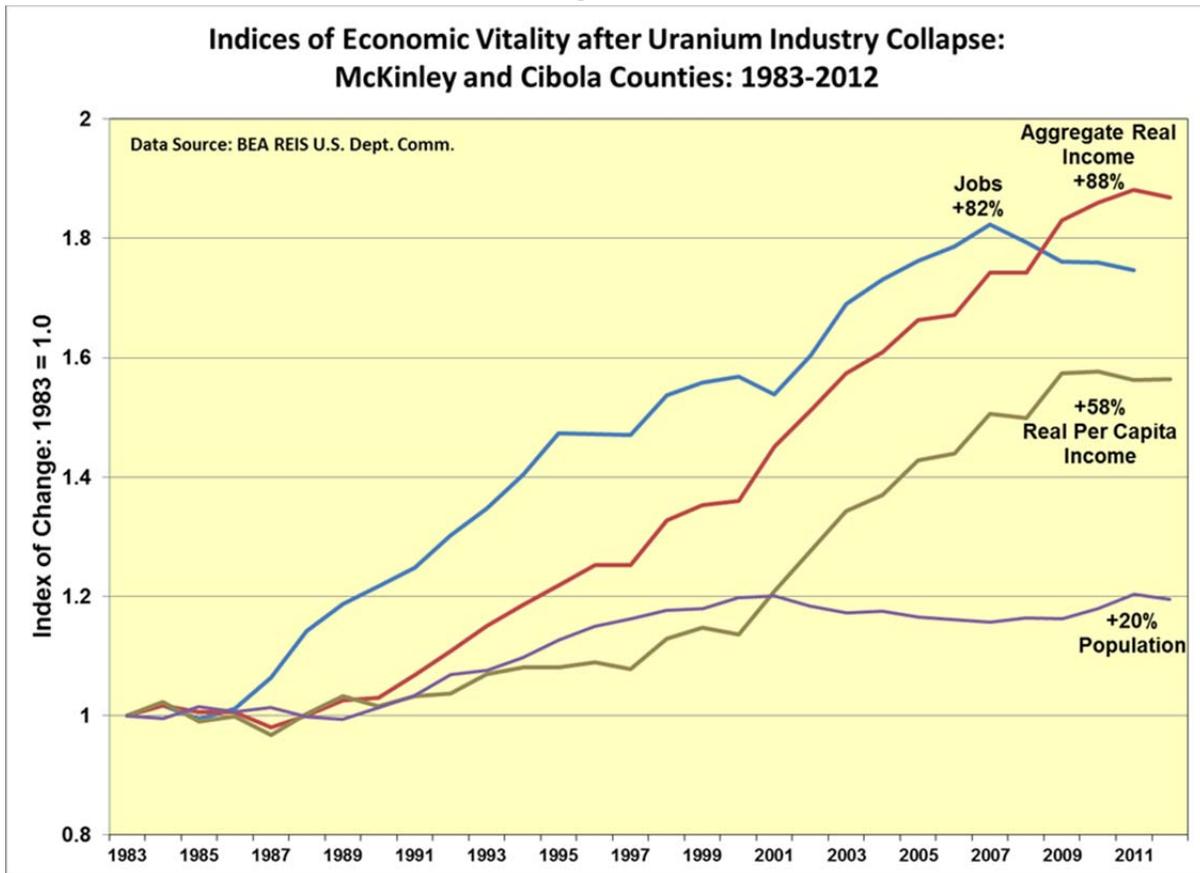
**7. Economic impact analysis, such as that carried out for the proposed Roca Honda Mine, assumes stable uranium prices and stable employment, payroll, and payments to state and local governments. This is unrealistic and misleading. It tends to exaggerate the claimed positive economic impacts associated with uranium mining.**

An employment opportunity that can reasonably be expected to last for a decade or several decades is a more beneficial addition to a local economy than jobs that can be expected to come and go as a result of continuing commodity cycles on international markets. The former helps stabilize a community. The latter tends to disrupt communities. That is why it is important in economic impact analysis of proposed mining operations to take a realistic view of the fluctuations that can be expected in the claimed positive impacts: jobs, payroll, and government revenues.

**8. McKinley and Cibola Counties have shown impressive local economic vitality and improvements in local economic well-being since the collapse of the uranium industry in the early 1980s.**

Between 1983 and the onset of the Great Recession in the years following 2007, total real income received by residents increased 88 percent, jobs increased 82 percent, real per capita income rose 58 percent, and population rose 20 percent. See Figure ES-4 below. In addition, the unemployment rate in McKinley and Cibola Counties declined from 10 and 14 percent, respectively, in 1996, a decade before the onset of the Great Recession, to about 4 percent in both counties and the state of New Mexico in 2007, just as the Great Recession began driving unemployment rates up across New Mexico and the rest of the nation.

Figure ES-4.



These positive statements about the performance of the McKinley and Cibola County economies since the uranium bust are not meant to suggest that economic conditions in McKinley and Cibola Counties are what residents wish they were. Average incomes remain below those of New Mexico as a whole and even farther below average relative to the nation as a whole. In 2012 the unemployment rate in McKinley County was 8.7 percent while that for New Mexico was almost two percentage points lower, 6.9 percent.

The unemployment rate in Cibola County was 6.2 percent in 2012, below that of the state of New Mexico as a whole. It should be kept in mind, however, that the official unemployment rate typically significantly underestimates the actual level of unemployment and under-employment.

The two counties that make up the study area for the Roca Honda Mine have among the highest percentages of Native Americans as any counties in the nation: about 75 percent in McKinley and 41 percent in Cibola. There are fewer than 10 of America's 3,100 counties where Native Americans make up a larger percentage of the population than in McKinley County and less than 20 counties with Native American populations that have a larger percentage of total population than in Cibola County.<sup>2</sup> Reservation counties have tended to be plagued by high unemployment and poverty rates that depress average income levels.

Both counties are also rural counties which typically have lower per capita incomes than metropolitan counties.<sup>3</sup> The per capita income in New Mexico as a whole is dominated by its four metropolitan areas where about two-thirds of the New Mexico population resides. So it is not surprising that non-metropolitan counties in New Mexico have lower per capita incomes than New Mexico as a whole. Similarly, the per capital income of the United States is dominated by the 85 percent of the population that lives in metropolitan areas.<sup>4</sup> So when we compare McKinley and Cibola Counties with the United States as a whole, we are effectively comparing rural counties with the nation's largest urbanized counties.

---

<sup>2</sup> <http://www.indexmundi.com/facts/united-states/quick-facts/all-counties/american-indian-and-alaskan-native-population-percentage> .

<sup>3</sup> *Post-Cowboy Economics: Pay and Prosperity in the New American West*, T.M. Power and R.N. Barrett, Island Press: Washington D.C., 2001, Chapter 5.

<sup>4</sup> U.S. Department of Agriculture, Economic Research Service, <http://www.ers.usda.gov/topics/rural-economy-population/population-migration.aspx> .

## Table of Contents

<b>Executive Summary</b> .....	<b>iii</b>
<b>Introduction</b> .....	<b>1</b>
<b>I. The “Economic Impacts” of the Proposed Roca Honda Mine</b> .....	<b>2</b>
1. The Limits of “Economic Impact Analysis” .....	2
2. The Economic Impacts Estimated for the Roca Honda Mine: U.S. Forest Service and Arrowhead Center .....	3
3. Correcting the Exaggerated Economic Impacts of the Proposed Mine .....	6
A. Stating Economic Impacts in Annual Terms, Not as a Cumulative Sum over the Entire Life of a Mine .....	6
B. Over-Statement of Impact “Multipliers” .....	8
C. The Economic Impacts Reported in the DEIS Grossly Exaggerate the Positive Impacts of the Propose Roca Honda Mine .....	10
4. Conclusions: The Local “Economic Impacts” of the Proposed Roca Honda Mine .	12
<b>II. The Economic Impact of the Inherent Instability of Uranium Markets</b> .....	<b>14</b>
1. Recent Failures to Accurately Predict the Demand for Uranium .....	14
2. Projecting Future Nuclear Generation and Demand for Uranium.....	19
3. The Impacts of Fluctuating Uranium Prices .....	20
4. The Unstable History of Uranium and Other Metal Mining in New Mexico.....	21
5. The Future Adequacy of Uranium Supplies .....	30
<b>III. The Local Economy in the Roca Honda Mine Study Area</b> .....	<b>34</b>
1. Introduction .....	34
2. The Economic Recovery of the McKinley-Cibola Study Area from the Uranium Bust .....	36
A. The Impact of the Commuting Patterns of Miners and Other Workers .....	37
B. The Growth of Wages and Personal Income.....	38
C. Changes in Population .....	40
D. Changes in the Sources of Income .....	41
E. Changes in Average Real Income.....	41
F. Changes in Unemployment .....	44
3. Conclusions on Cibola and McKinley County Areas’ Adjustment after the Uranium Mining Boom and Bust.....	45

**Appendix: The Errors in the USFS Cibola National Forest Estimates of the Local Impacts of the Proposed Roca Honda Uranium Mine..... 48**

- A. Stating Economic Impacts as a Cumulative Sum over the Life of a Mine..... 48
- B. Over-Statement of Impact “Multipliers” ..... 50

**Bibliography ..... 55**

# **Getting Beyond the Hype: A Critical Review of the Economic Impacts of the Roca Honda Uranium Mine**

## **Introduction**

Roca Honda Resources LLC has proposed a uranium development project that would involve a mine and, originally, a uranium mill, in the vicinity of the city of Grants, New Mexico. The uranium mine would make use of Cibola National Forest land and Roca Honda Resources has submitted a mining proposal to the U.S. Forest Service for approval. Roca Honda Resources has not yet sought federal approval of the proposed uranium mill. Because Energy Fuels has purchased the controlling interest in Roca Honda Resources and Energy Fuels already owns the only operating uranium mill in the U.S., the White Mesa Mill near Blanding, UT, that existing mill may be used to process the uranium ore from the proposed Roca Honda Mine rather than building a new mill.

Power Consulting, Inc. was asked by the Multicultural Alliance for a Safe Environment (MASE) to review the purely positive economic impacts that the proponents of the proposed Roca Honda Mine have claimed will result if that mine is built and operated. Those claimed benefits include new employment, wages and salaries, and revenues to state and local governments that would be directly and indirectly generated by the proposed Roca Honda Mine.

This report provides a critical review of those claimed benefits using the information provided by Roca Honda Resources to both the Cibola National Forest and the Arrowhead Center at New Mexico State University. Those two public agencies produced economic impact reports based on the Roca Honda information. We also draw on technical mining analysis that Roca Honda Resources commissioned to analyze the economic feasibility of the proposed mine.

This report is organized in the following manner: The first section looks carefully at the claimed positive economic impacts of the Roca Honda Mine, especially the employment and payroll impacts. Exaggerations and errors in the statements of these impacts are removed and corrected and the resulting economic impacts are compared with the existing economy in the region where the mine would be located in order to evaluate the relative size and importance of those claimed beneficial economic impacts.

The second part of the report evaluates the likely stability and reliability of the claimed benefits of the proposed mine given the historical instability in uranium industry production, employment, and payroll. That historical experience with uranium mining in New Mexico informs our evaluation of the contribution that the proposed mine can make to the local economy in the future.

The third part of the report puts the proposed Roca Honda Mine in the context of the economy of McKinley and Cibola Counties where almost all of New Mexico's uranium production has taken place. The experience of these counties during the past uranium booms and bust and the evolution of their economies since the collapse of the uranium industry in the first half of the 1980s creates a backdrop against which we can evaluate the relative contribution of the proposed Roca Honda Mine to the future local economy.

## I. The “Economic Impacts” of the Proposed Roca Honda Mine

### 1. The Limits of “Economic Impact Analysis”

The likely changes to the economic vitality of communities and economic well-being of residents caused by a proposed industrial facility such as a mine, mill, or factory are often estimated by carrying out an “economic impact analysis.” Although this name commonly applied to this sort of analysis suggests that *all* economic impacts are being studied, that usually is not the case. Instead, the term “economic impact analysis” has usually been used to describe a type of analysis that proponents of a particular project carry out as part of the public relations effort to gain public support and approval for their project. Gaining that local support for the proposed project is often challenging because of the perceived *costs* associated with the industrial project. “Economic impact” analysis is the industry's response to those cost concerns.

However, instead of looking at all economic impacts associated with the project, this type of analysis looks *only* at the perceived *benefits* of the project, usually the jobs, payroll, and revenue flows to governments that are projected to be associated with the mine proposal. In that sense, such an “economic impact analysis” is actually a selective presentation of the proponents' claims of the benefits of the proposed project. Since economic analysis typically looks at both benefits and costs and one of the principles of economics is that there are rarely “free lunches,” i.e. costless benefits, available, a listing of only a set of selective benefits of a project while ignoring costs cannot be labeled an *economic* analysis.

“Economic impact analysis” in support of proposed projects is also typically built around a primitive and incomplete depiction of the dynamics of a local economy, namely an “export base” view of the local economy. That view of the local economy, as the name suggests, hypothesizes that it is only exports from the local economy that can stimulate local jobs and income growth because it is only that type of economic activity that brings new money into the local economy where it circulates putting people to work in locally-oriented economic activity. In that sense, the claim is that “only exports matter.” Exports are the force that drives the local economy. That assertion justifies a focus exclusively on the benefits associated with new export-oriented economic activities.

As common and popular as this view of the economic dynamics of the local economy may be, it is seriously incomplete. It basically assumes that the distribution of economic activity is entirely determined by where export-oriented businesses choose to locate. Those business decisions create a demand for workers and workers and their families move to the location of the industrial facility, earn and spend money, and a local economy develops around those export-oriented firms.

Although this is typically presented as a simple and obvious economic fact of life, it is no such thing. It hypothesizes that only labor demand matters when it comes to the location of people and economic activity across the national economy. Economic analysis almost always insists that it is the interaction of demand *and supply* that determine economic outcomes. What is missing from the export base view is any role for labor supply or the location of markets for goods and services.

The basic assumption built into the export base view is that people go to where the jobs are. People have no preferences for where they live or, if they do, those preferences have no economic implications. The export base view also assumes that businesses do not care where the workforce they need is located or where the population that represents the markets for their goods is located. Neither of these assumptions, in general, is true. The adequacy and cost of the necessary workforce for an economic operation has always been an important concern to businesses firms making a location choice as has the location of the customers to whom those businesses hope to sell their goods or services.

When labor supply, market location, and people's, including business owners', preferences for various types of living environments (local "amenities") are recognized, it becomes clear that the dynamics of local economic vitality and well-being cannot be accurately described in terms of "only exports matter." In particular, the characteristics of a local area that make it an attractive place to live, work, raise a family, and do business become important determinants of local economic vitality and well-being that cannot be ignored in local economic analysis. Those local social and environmental amenities become economic resources whose protection or degradation has important economic implications.

## **2. The Economic Impacts Estimated for the Roca Honda Mine: U.S. Forest Service and Arrowhead Center**

The U.S. Forest Service Draft Environmental Impact Statement (DEIS) for the proposed Roca Honda uranium mine used the economic impact model IMPLAN to estimate the impacts of the proposed Roca Honda Mine on a selected group of expected benefits, namely employment, payroll, and economic output in a study area consisting of

McKinley and Cibola Counties, New Mexico.<sup>5</sup> The IMPLAN model name refers to “Impact analysis for PLANing.” That is, it is intended to be an analysis of economic impacts. It is a widely used “economic impact analysis” tool with all of the limitations discussed above.

In addition, Roca Honda Resources contracted with the Arrowhead Center at New Mexico State University to estimate the economic impacts that would be associated with the proposed mine.

The U.S. Forest Service Roca Honda Mine DEIS summarized the “Economic Impact of Roca Honda Mine operation” in Table 63 (p. 294) of the DEIS. That DEIS table is reproduced below as Table 1. In that table we have reported the higher of the two direct jobs estimates, 220 and 253 jobs, found in the DEIS to indicate the jobs that will be directly created by the operation of the proposed mine.<sup>6</sup> That estimate of 253 direct mining jobs in the DEIS was close to the estimate of 247 mining jobs in the Roca Honda Technical Mining Plan which was released in early August of 2012.<sup>7</sup> The lower estimate of 220 direct mining jobs is similar to the lower estimate that Roca Honda Resources provided to the New Mexico Legislature in July 2013.<sup>8, 9</sup>

---

<sup>5</sup> Cibola National Forest, McKinley and Cibola Counties, New Mexico, U.S. Department of Agriculture, Forest Service, Southwestern Region, MB-R3-03-25, February 2013. The IMPLAN model was originally developed by the U.S. Forest Service for studying the impacts associated with the management of National Forest land. IMPLAN is now managed and sold by a private firm, IMPLAN Group, LLC. <http://implan.com/>

<sup>6</sup> DEIS, p. 288. The DEIS attributes these employment numbers to the Strathmore Minerals Corporation Vice-President for Environmental and Regulatory Affairs, Juan R. Velasquez.

<sup>7</sup> Technical Report on the Roca Honda Project, McKinley County, New Mexico, USA, prepared by Roscoe Postle Ltd. (RPA) for Roca Honda Resources, LLC, 2012. P. 21-12, Table 21-10.

<sup>8</sup> Meeting of the Economic and Rural Development Committee, July 8-9, 2013, Farmington, NM, slide 3. A footnote on that slide said that New Mexico State University Arrowhead Center developed the impact estimates in November 2012. But Roca Honda was likely the source of the direct mining employment.

<sup>9</sup> The employment and payroll opportunities associated with the proposed Roca Honda Mine are divided into three or four parts by the DEIS and the 2012 Technical Report. The Technical Report distinguishes the mine itself from the proposed uranium mill that would not be located at the mine site. The DEIS focuses only on the mine proposal since that is the facility for which Roca Honda Resources seeks approval from the U.S. Forest Service. Both documents distinguish jobs and payroll associated with the development of the mine (planning, permitting and construction) from the jobs associated with the operation of the mine. After the mine enters the closure phase, there will also be jobs associated with reclamation of the mine site. Since the direct construction or development jobs are short-term jobs which will average 100-150 jobs per year for a 3-year period (DEIS p. 291) and the direct reclamation jobs number only 30 jobs per year over a two-year period (DEIS p. 294), we have focused our analysis on the longer-term mining jobs, i.e. the jobs associated with the operation of the mine.

**Table 1.**

<b>Economic Impact of Roca Honda Mine Operation</b>			
Type of Impact	Employment	Wages and Salaries	Sales Value of Mine Output
Direct Effect	253	\$160,565,612	\$498,709,856
Indirect Effect	140	\$6,644,009	\$29,366,608
Induced Effect	791	\$22,700,866	\$78,963,010
<b>Total Effect</b>	<b>1184</b>	<b>\$189,910,487</b>	<b>\$607,039,474</b>

Source: Roca Honda DEIS, Table 63, p.294.

In economic impact analysis, the “direct” impacts refer to the actual number of jobs expected to be created at the mine, including both workers directly hired by Roca Honda and workers associated with firms with which Roca Honda has contracted to provide services at the mine site. The “indirect” impacts are the impacts of the mine’s purchases of supplies, goods and services, from other firms in order to keep the mine operating. The indirect impacts are the jobs, payroll, and economic activity created off-site by the mine’s purchases. The “induced” impacts are the impacts associated with the mine workers and the workers in the supplying firms spending their pay. Those indirect and induced impacts are the “ripple” or “multiplier” impacts associated with the direct economic activity at the mine. The last column in Table 1 above is the sales value of the output created at the mine (direct), at the mine supply firms (indirect), and the other businesses in which mine-related workers spend their wages and salaries (induced).

As shown in Table 1, the DEIS estimates very large *total* impacts from a mine that directly employs only 253 workers. The total employment, once the ripple effects are taken into account, is estimated to be almost five times as large as the mine employment itself, almost 1,200 total jobs. Even more impressive is the estimated payroll associated with the jobs at the mine, about \$161 million dollars. The total payroll after ripple effects are included is almost \$190 million and total sales value associated with the proposed mine is \$607 million.

Roca Honda, commissioned by the Arrowhead Center, also estimated the economic benefits of the proposed mine. The results of that mine-sponsored estimate of mine benefits, had not been released as a report as of April 2014. The Arrowhead results, however, were contained in a presentation that Roca Honda Resources made to a New Mexico legislative committee in July 2013.<sup>10</sup> The Arrowhead Center focused on the same local study area that the U.S. Forest Service used, McKinley and Cibola Counties. Table 2 below summarizes those projected economic impacts of the operation of the proposed mine. These estimated local economic impacts of the proposed mine are

<sup>10</sup> Op. Cit. “Roca Honda Resources LLC Mine Project. Second Meeting of the Economic and Rural Development Committee, July 8-9, 2013, Farmington, NM.” Page 3.

even larger than those estimated by the U.S. Forest Service in the DEIS, especially the job impacts.

**Table 2.**

Arrowhead Center Roca Honda		
Mine Operations Local Economic Impacts		
Type of Economic Impact	Jobs	Labor Income
Direct	2,460	\$184,500,000
Indirect & Induced	1,663	\$56,800,000
Total	4,123	\$241,300,000

Source: Information provided by Arrowhead Center to Roca Honda Resources, November 2012.

### 3. Correcting the Exaggerated Economic Impacts of the Proposed Mine

#### A. Stating Economic Impacts in Annual Terms, Not as a Cumulative Sum over the Entire Life of a Mine

The U.S. Forest Service economic impact IMPLAN modeling results that were reported in the DEIS for the proposed Roca Honda Mine and in the information the Arrowhead Center developed for Roca Honda Resources are presented in a way that seriously exaggerates the likely economic impacts. As a result of incorrect labels and an unconventional method of portraying the benefits of the mine over its life, the estimated economic benefits of the proposed mine were made to appear much larger than they actually are likely to be.

In particular, the DEIS and Arrowhead analyses of the benefits of the Roca Honda mine exaggerated those benefits by reporting the sum of the annual benefits over the life time of the mine. It is critical to correct those exaggerations and present the economic impact results in *annual* terms.

Consider the direct economic impacts reported in the DEIS and reproduced in Table 1 above. If one divides the claimed wages and salaries paid to the workers at the proposed mine by the number of workers, the implied wage is \$730,000. It is extremely unlikely that Roca Honda is planning to pay each of its mine workers almost three-quarters of a million dollars per year. If, instead, one divides the salaries and wages associated with the reported number of indirect jobs created, the implied annual wage is \$47,457 per job. The mine workers, apparently, will get paid over 15 times as much as the workers in mine supply businesses. That, too, is very unlikely, although the wage level for the mine supply workers is a much more believable annual wage

In general, economic impacts are reported on an annual basis. This is important because the time dimension of the job or payroll or tax impact has to be specified or the numbers reported cannot be compared or evaluated. For instance, if a mine were projected to operate for 30 years with a workforce of 500 and the annual pay associated with the mining jobs was \$60,000, reporting that 15,000 jobs would be created or that the average pay associated with each job was \$1.8 million would be grossly misleading. The economic impacts would vary widely depending on the expected life of the operation of the mine. The conventional standard for the reporting of such economic information is to report annual impacts and then, if it is important, also report on the number of years over which that annual economic impact was expected to last.<sup>11</sup>

Roca Honda Resources also reports its estimated mine economic impacts as a sum of annual impacts over the life of the mine, often without indicating that that is what is being done. For instance Roca Honda Resources presentation on the economic impacts of the proposed mine to the New Mexico Legislature, it presented the results of an economic impact analysis done for it by the Arrowhead Center of New Mexico State University. The employment, payroll, and government tax revenues were all sums over the life of the mine without that being specifically stated. Roca Honda, however, *also* did state the job impacts in terms of average annual jobs.<sup>12</sup>

In 2008 the Arrowhead Center released a report on “The Economic Impact of Proposed Uranium Mining and Milling Operations in the State of New Mexico” that had been commissioned by the Uranium Producers of New Mexico.<sup>13</sup> The “proposed uranium mining and milling operations” included the construction of 15 mine and three mills over the 2008-2012 period. Those uranium facilities were then assumed to operate uninterrupted for 30 years. Those new uranium facilities would have been located primarily in McKinley and Cibola Counties.<sup>14</sup>

The Arrowhead Center’s estimated economic impacts of this projected major expansion of uranium activities were huge. The direct employment in the uranium mines and mills was projected to be almost 98,000 workers earning wages and salaries totaling over \$8 billion. With ripple or multiplier impacts included, the total employment impact was almost a quarter of a million workers with a payroll impact of over \$14 billion.<sup>15</sup>

---

<sup>11</sup> There are situations where jobs may last less than a year or for only a few years (e.g. construction jobs). In that setting “man-years” or “worker-years” of labor effort may be reported. Similarly, some jobs are part-time and employment impacts may be exaggerated if full-time and part-time jobs are added together. In those setting, “full-time-equivalent jobs” may be calculated. What is important is that specific language is used to distinguish these aggregations of jobs across time periods from “jobs,” “employment,” “income,” “payroll,” or “tax payments,” which are always reported on an annual basis.

<sup>12</sup> Op. Cit. Roca Honda Resources’ presentation to a meeting of the Economic and Rural Development Committee, July 8-9, 2013, Farmington, NM, slide 3. A footnote on that slide said that New Mexico State University Arrowhead Center developed the impact estimates in November 2012.

<sup>13</sup> James Peach and Anthony V. Popp, New Mexico State University, August 1, 2008.

<sup>14</sup> Ibid. p. 80. This was the “base case.” High and low impact scenarios were also analyzed.

<sup>15</sup> Ibid. p. 8.

But, in 2008 the total jobs in McKinley and Cibola Counties in all lines of work totaled only about 41,000. Those jobs paid wages and salaries totaling about \$1.4 billion.<sup>16</sup> An increment of 98,000 new jobs in McKinley and Cibola Counties paying \$8 billion would represent a spectacular and sudden change in those two rural counties.

But even though the Arrowhead Center summarized the direct impacts of the “proposed” new uranium industry in those two counties with these huge numbers, that is probably not what they meant to convey. These very large employment and payroll impacts were the sum of the actual *annual* impacts over the assumed life of the “proposed” new uranium facilities. To obtain actual number of jobs being created and the actual annual payroll that would be paid, one has to divide these Arrowhead Center estimated impacts the number of years those facilities are expected to be operated. The actual impacts the communities would experience would be a small fraction of the positive impacts projected: For an 11-year project life, the annual impact would be only 9 percent of what was reported. For a 30-year project life, the annual impact would be only 3 percent of what was reported.

### ***B. Over-Statement of Impact “Multipliers”***

There are also obvious problems with the size of the ripple or multiplier impacts reported in the Roca Honda DEIS and reproduced in Table 1 above. The employment multiplier implied by the estimated total number of jobs created (including the multiplier impacts) and the direct employment at the proposed mine is 4.68. It is extremely unlikely that the economies of the rural counties of Cibola and McKinley could support a job multiplier this size. A job multiplier of this size would imply that for every job directly created by the mine, close to 4 additional jobs would be created in Cibola and McKinley counties in support of the mine and the miners. Interestingly, the multipliers that the DEIS appears to apply to payroll and the value of economic output are much smaller, about 1.2. Apparently although lots of additional jobs are created, not much additional payroll is paid out and not much more is produced in the overall economy. This does not make sense.

The authors of the Roca Honda DEIS section on the economic impacts of the proposed mine seem to have been aware of the fact that the job multiplier should have been much smaller. In a comment box entitled “The Employment Multiplier” (p. 289), the DEIS gives an explanation and example of a hypothetical mine’s employment multiplier. The example used led to an employment multiplier of 1.3, not 4.7. A multiplier of 1.3 is also more consistent with the payroll and output multipliers of 1.2 in the DEIS. As discussed below, the employment multiplier implicit in Power Consulting’s IMPLAN modeling of the proposed Roca Honda mine is also 1.3.

---

<sup>16</sup> BEA REIS U.S. Department of Commerce. Earnings are stated in 2012 dollars.

Employment multipliers in the range of 4 or 5 occur, if ever, only when a very large and sophisticated urban economy is included as part of the study area. For instance, if the study area included the entire national economy, the calculated ripple or jobs multiplier impacts *might* be this large.

It should be pointed out that the job multiplier impacts that Roca Honda Resources reported to the New Mexico Legislature were much smaller than what the DEIS estimated: 1.7 instead of the DEIS estimate of 4.7. That is, the DEIS job multiplier is almost 3 times as large as the job multiplier estimated for Roca Honda Resources by the Arrowhead Center at NMSU.<sup>17</sup>

Power Consulting used the same IMPLAN model used by the U.S. Forest Service in the DEIS to model the proposed mine. We adopted the same study area (McKinley and Cibola Counties) and assumed the direct mine employment would be the higher of the two job numbers provided in the DEIS. Our results are shown in Table 3 below.

**Table 3.**

<b>Power Consulting IMPLAN Modeling of Proposed Roca Honda Mine</b>			
<b>McKinley and Cibola Counties Study Area Using DEIS Assumptions</b>			
<b>Type of Impact</b>	<b>Jobs</b>	<b>Labor Income</b>	<b>Sales Value of Output</b>
Direct	253	\$15,177,164	\$45,337,260
Indirect	11.9	\$597,507	\$3,434,672
Induced	76.9	\$2,168,828	\$7,973,287
Total	340.8	\$17,943,499	\$56,745,220

Note that our estimated job multiplier impacts, the ratio of total jobs to direct jobs, are much smaller. Every 10 direct mining jobs have ripple effects that lead to another 3.5 jobs in McKinley and Cibola Counties, not the 36.8 additional jobs that the DEIS projects. Also note that the labor income associated with direct jobs, is only a fraction of what the DEIS projected. The implied average wage in mining is \$60,000 not \$730,000 per year.

The DEIS substantially exaggerated the “ripple” or multiplier impacts associated with the proposed Roca Honda Mine.

---

Ibid. The direct mining jobs were 224 while the total jobs were 375 per year.

### ***C. The Economic Impacts Reported in the DEIS Grossly Exaggerate the Positive Impacts of the Propose Roca Honda Mine***

The point of these calculations has be to demonstrate that the Roca Honda DEIS reported the positive economic impacts in an inconsistent manner, mixing annual impacts with impacts over the life of the mine. The result was implausibly large implied annual wages and implausible employment multipliers. An appendix at the end of this report goes into more detail on the errors contained in the local economic impacts the DEIS estimated.

Conventionally, economic impacts are presented in annual terms. When a worker first gets a new salaried job, her employer generally would not tell her the amount of money that she would receive over an eleven year period or her lifetime if the job lasted that long. Setting professional sporting contracts aside, general convention would use *annual* employment, *annual* salaries and wages, and *annual* economic activity or sales value. When we remodel the impact of the Roca Honda project on Cibola and McKinley Counties *on an annual basis*, the table of projected local impacts are much smaller. See Table 3 above.

The ripple or multiplier impacts for employment, payroll, and the value of mine output are appropriately smaller and similar: 1.35 for jobs, 1.2 for payroll, and 1.25 for value of output. The smaller ripple or multiplier effects is what would be expected given the rural nature of Cibola and McKinley counties, which would very likely have a hard time supporting much of the mining-related employment besides the direct jobs in the mine. In other words, it is very likely that much of the “ripple effect” on employment and mine output would leak out of these rural counties to the larger metropolitan areas like Albuquerque or to other trade centers in the nation.

This leakage of economic activity associated with the mine out of these rural counties should not come as a shock. A uranium mine requires large, capital intensive purchases of mining equipment that could not possibly be manufactured or purchased in Cibola or McKinley counties. Cibola and McKinley counties do not, for instance, have a manufacturing facility for “966 Front-end Loaders,” “D-6 Dozers,” “dump trucks,”<sup>18</sup> or any of the other specialized heavy equipment required for the proposed Roca Honda mine.<sup>19</sup> A large metropolitan area like Albuquerque, which dwarfs the Cibola and McKinley county economies, is much better suited to sell or even manufacture technical mining equipment. Albuquerque is the largest city in New Mexico; it is within 100 miles of the proposed Roca Honda mine; and it has a diversified economy with a population

---

<sup>18</sup> Op. cit. Technical Mining Plan, 2012, Table 18-2 Surface equipment fleet, p. 18-10.

<sup>19</sup> IMPLAN version 3 Study Area Data for McKinley and Cibola counties shows no employment in Heavy duty truck manufacturing (or any other type of metal equipment manufacturing aside from a small amount of employment in trailer manufacturing).

approaching one million people.<sup>20</sup> Cibola and McKinley counties, in comparison, have a combined total population of about a tenth of the city of Albuquerque.<sup>21</sup>

Even if the value of the mine output is more than doubled, and the salary per direct worker is raised to \$75,000 per year rather than the \$60,000 the DEIS assumed, and the larger number of direct mine workers, 253, is used, the multiplier for direct to total jobs is still only 1.53.<sup>22</sup> This is only a small fraction of the 4.68 job multiplier implied by the DEIS Table 63. The total employment including ripple effects after making all of these upward adjustments would be 387 jobs. This highlights the quite modest potential economic impacts of a uranium mine of this size. Even if the total value of the output of the mine is more than doubled and the assumed annual pay per mine worker is increased 50 percent, the total employment for the region increases by only 50 workers beyond the direct hires at the mine.<sup>23</sup>

---

<sup>20</sup> ["Metropolitan and Micropolitan Statistical Areas Totals: Vintage 2011 - U.S Census Bureau"](#).

Census.gov. Retrieved 2013-06-27.

<sup>21</sup> IMPLAN version 3, model year 2011.

<sup>22</sup> The Power Consulting IMPLAN analysis was based on 253 directly employed miners, an annual pay of \$75,000, and direct annual output of \$105,945,088 based on the RPA "Technical Report on the Roca Honda Project, McKinley County, New Mexico, U.S.A." The Arrowhead Center analysis of the proposed mine for Roca Honda Resources estimated the average annual pay of the miners at \$75,000. Op. cit. Roca Honda Resources LLC Mine Project presentation to N.M. Legislature, 2013, p. 3.

<sup>23</sup> It should be pointed out that the dollar value of the output of the mine, i.e. the sales value, which the DEIS labels the level of "economic activity," is not a very relevant number when estimating local economic impacts. The dollar value of output has to cover the costs of the workforce both local and national, the supplies and services purchased even if purchased in national or international markets, the debt payments, dividend payments, and other forms of profit, etc. In that sense the value of output does not measure local impacts and double counts the wages and salaries and other value added. It is one of the largest numbers associated with the mine that can be stated, which makes it attractive for public relations purposes. But it is not a very relevant number in terms on actual local impacts.

Nonetheless, it appears that the DEIS IMPLAN modeling used the wrong sales value for the output of the proposed mine in the last column of the tables above. The value of the output of the mine listed in Table 63 of the DEIS is about \$500 million (see Table 1 above). If one carries the direct value of the uranium mined through, from the values given in the DEIS on p. 293, the direct output could be as large as \$1.7 billion. If the DEIS's direct output is to be believed, it implies that less than one third of the value of the estimated uranium reserves contribute toward the value of the direct output. If the 2012 Technical Mining Plan (Tables output associated with the mine that was used in the DEIS is still less than half of what was used to model the economic impacts in the DEIS. It is unclear as to what the source of the DEIS's estimate of the value of the mine's output was. The DEIS citation given for this economic information cites a personal communication (DEIS p. 487) in response to an information request to Roca Honda Resources from the Cibola National Forest about "socioeconomic questions." This leaves the source of this inconsistency in the projected economic impacts unclear.

## 4. Conclusions: The Local “Economic Impacts” of the Proposed Roca Honda Mine

Conventional “economic impact analysis” focuses exclusively on the *benefits* of a proposed industrial facility. That type of analysis, by design, ignores any costs associated with the proposed project that might have negative impacts on local economic vitality or economic well-being. In addition, the analytical methods used tend to oversimplify the sources of local economic vitality, focusing exclusively on only one potential set of economic development forces while ignoring others. Although this is useful from the point of view of a firm’s public relations efforts to get its proposed project approved, it is incomplete and potentially misleading as economic analysis.

The economic impact analysis presented in the Roca Honda DEIS and the economic impact analysis done for Roca Honda Resources were also simply inaccurate because they mixed annual impacts with impacts over the life of the proposed mine and likely used the wrong value of the value of the mine’s output. The first of these exaggerated the expected employment, payroll, output, and government revenue impacts eleven-fold. The second led to a much smaller *understatement* of these impacts. Overall the DEIS significantly overstated the positive local impacts of the proposed mine.

If those errors are corrected, the revised DEIS economic impacts are consistent with the IMPLAN re-modeling that Power Consulting carried out for the proposed Roca Honda on the same two-county study area (McKinley and Cibola Counties), using the DEIS assumptions stated on an annual basis.

Those estimated positive economic impacts on the local study area affected by the proposed mine are quite modest. The direct employment at the proposed mine according to the Roca Honda Technical Report would be 247. The DEIS, based on information from Roca Honda Resources estimated the mine employment, at a maximum, to be 253.<sup>24</sup> The Arrowhead Center, in its analysis for Roca Honda Resources, reported direct mine employment of 224, close to the lower estimate provided by the DEIS.<sup>25</sup>

With “ripple” or “multiplier” effects taken into account, the total employment effects in McKinley and Cibola Counties combined, ignoring any negative effects of the mine, would be about 375 jobs that would last 9 to 11 years.<sup>26</sup>

---

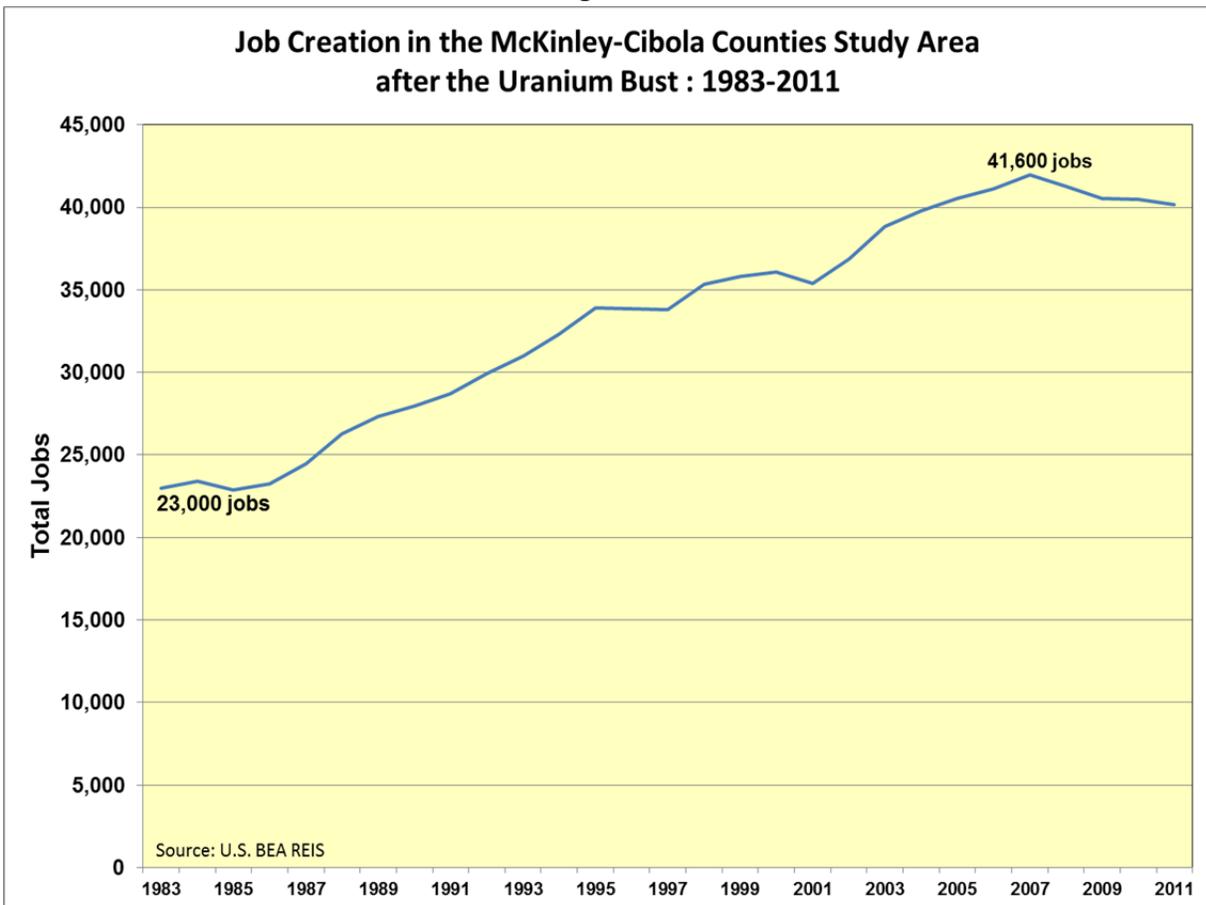
<sup>24</sup> Op.Cit. Technical Report 2012, Table 21-10, p. 21-12. According to the Technical Report there would be 247 mine workers plus 16 maintenance workers who would also provide maintenance to the proposed mill that would not be located at the mine site. There would also be an administrative staff of 23 responsible for the entire mine and mill operation who would not necessarily be located in the local area. If half of the maintenance staff is needed for the mine, total mine employment would be 255. This is close to the DEIS’s higher stated mine employment of 253.

<sup>25</sup> Op. Cit. Roca Honda Resources Project, 2013 presentation to New Mexico Legislature, p. 3.

<sup>26</sup> Ibid. That is the Arrowhead Center’s estimate of the total annual employment impact. The DEIS estimate adjusted for higher mining wages and a higher value of mine output would lead to an estimate of

This number of jobs has to be put into the context of the local economy. In the period after the uranium industry bust in the early 1980s and the beginning of the Great Recession (1983-2007), about 19,000 jobs were added to the McKinley-Cibola area economy, an increase of 82 percent. On average about 790 jobs were added each year over this 25 year period. See Figure 1 below.

Figure 1.



The 375 jobs associated with the proposed mine would represent less than one percent of total jobs in 2011. That number of jobs was added to the study area economy, on average, every six months over the last 25 years. Put slightly differently, the total jobs associated with the operation of the proposed mine, *if* the mine has no negative impacts, represent about six months of normal job growth in McKinley and Cibola

387 total jobs. These are the jobs associated with the operation of the mine. The DEIS assumed that the operation of the mine would last 11 years. The Technical Report on the mine assumed an life of the mine of a little over 9 years. But there would be a two year ramp-up period. Op. cit. Technical Report 2012, Table 1-4 and p. 22-1.

Counties. The same is true of the projected annual payroll associated with the proposed mine: It represents about 6 months of normal personal income growth in the two-county study area and slightly less than one percent of 2012 personal income. Clearly, the jobs and payroll associated with the proposed Roca Honda Mine are unlikely to have a major positive impact on the local area.

This type of analysis, however, simply assumes that uranium markets will continue to support the mine at its planned level of operation across the life of the mine. That is what the operators of the mine *hope* will be possible. But the history of uranium mining in New Mexico and across the nation indicates that such optimism about how international markets will provide steady support for uranium mining is misplaced. Stability in uranium prices, production, employment, payroll, and payments to state and local governments has *not* been typical of the uranium industry. This suggests that the *actual* positive impacts of the operation of the mine will be irregular and potentially disruptive to communities near the mine. It is to this instability associated with the uranium industry to which we turn next.

## II. The Economic Impact of the Inherent Instability of Uranium Markets

### 1. Recent Failures to Accurately Predict the Demand for Uranium

During the 2006-2008 period, high uranium prices led many in New Mexico to speculate that New Mexico's once extensive uranium mining industry that had collapsed to near zero activity in the early 1980s might experience a renewed boom that would bring an economic renaissance to McKinley and Cibola Counties.

During that period the Uranium Producers of New Mexico hired the Arrowhead Center at New Mexico State University to detail the economic benefits that would flow from this expected widespread revitalization of the uranium mining industry ("Arrowhead Report").<sup>27</sup> That Arrowhead Report projected that after a five-year period of investment in the construction of new mines and mills, 30 years of uranium mining would develop almost all of the uranium reserves that the U.S. Department of Energy estimated were located in New Mexico. Annual production over that 30-year period, 2012-2042, was projected to average 10.4 million pounds of uranium per year, almost identical to the rate of production during the 1955-1985 uranium boom period in New Mexico.<sup>28</sup> The

---

<sup>27</sup> "The Economic Impact of Proposed Uranium Mining and Milling Operations in the State of New Mexico," James Peach and Anthony V. Popp, Office of Policy Analysis, Arrowhead Center, Inc, New Mexico State University, Las Cruces, NM, August 1, 2008.

<sup>28</sup> Ibid. Projected uranium production from Figure 1.5 and p. 13. Past production is from New Mexico Mining and Minerals Division, Energy, Minerals and Natural Resources Department and the Energy Information Administration, U.S. Department of Energy.

value produced by the new uranium boom was projected to be close to \$26 billion dollars and the employment impact was estimated at an astonishing 249,000 jobs.<sup>29</sup>

Power Consulting, Inc., at that time, criticized the Arrowhead Report for both exaggerating the imminence of a new uranium boom in New Mexico and exaggerating the expected net economic benefits of the expansion in uranium mining to McKinley and Cibola Counties.<sup>30</sup>

The Arrowhead Report used an estimated price for uranium of \$90 to \$100 per pound, a price that it projected would be sustained at that level or higher for 30 years. During the May 2007 through May 2008 period uranium long-term contract prices *were* in this range. Between March 2007 and December 2007 spot market uranium prices were actually in this range, peaking in mid-2007 at \$143 per pound.<sup>31</sup>

Based on the assumption that those high uranium prices would continue indefinitely, the Arrowhead Report, trusting uranium mining companies' stated mining plans, projected that between 2008 and 2012 *fifteen* uranium mines and *three* uranium mills would be constructed in New Mexico.<sup>32</sup> This was Arrowhead's "base case" that it said "may understate future uranium operations in New Mexico to the extent that not all potential projects have been included...Trends and projections of world and national energy markets...provide strong evidence that the [Arrowhead Center] base case scenario is a genuine possibility."<sup>33</sup>

Of course, as of early 2014, none of these fifteen uranium mines and none of the mills that were supposed to be operating by then in New Mexico had been constructed. New Mexico's uranium production remains zero. Energy Fuels, which originally proposed to build the Roca Honda mine *and* a mill has shut down or planned to shut down its own uranium mines in the United States and also planned to shut down in 2014 the only operating uranium mill in the United States, the White Mesa Mill near Blanding, Utah, which Energy Fuels owns.<sup>34</sup>

The reason for the failure of this projected uranium mining renaissance to materialize in New Mexico as the Arrowhead Report projected in 2008 was the decline in the market price of uranium to levels well below the high levels that the Arrowhead Report had projected would last for 30 years. The Arrowhead Center's projected boom in New Mexico uranium mining and milling activities was tied to the continuation of the unusual

---

<sup>29</sup> Op. cit. Arrowhead Report, p. 8. Both figures include the impact of mine and mill construction as well as the impact of the operation of the mines and mills over 30 years.

<sup>30</sup> "An Economic Evaluation of a Renewed Uranium Mining Boom in New Mexico," Thomas Michael Power. 2008. A report prepared for the New Mexico Environmental Law Center.

<sup>31</sup> Ibid. p. 39.

<sup>32</sup> Ibid. p. 80.

<sup>33</sup> Ibid.

<sup>34</sup> Energy Fuels bought the White Mesa uranium mill and nuclear waste disposal facility. White Mesa may still be taking nuclear waste for reprocessing but is not accepting uranium ore as of January 2014.

spike in uranium prices in 2007-2008. That spike quickly collapsed and uranium prices fluctuated downward, except for a modest recovery from mid-2010 to early 2011. See Figure 2 below, which shows the movement of uranium prices from 2004 through the beginning of 2014. The spot market price, the price associated with the purchase and deliveries that take place within less than a year, is shown by the dashed line. It reflects the day-to-day active buying and selling of uranium. Also shown on Figure 2 is the price agreed to in new long-term contracts that electric utilities enter into to obtain their nuclear fuel. Those long-term contracts for the delivery of uranium generally extend five years into the future in the U.S.

**Figure 2.**

**Market Price of Uranium: Spot and Long-Term Contract**



When the Arrowhead Report was released in August 2008, the spot market price had already tumbled from almost \$140 per pound to \$60. The Arrowhead Center dismissed this decline in spot market prices: “Recent volatility in the spot price of uranium does not change substantially the long-term supply and demand outlook.”<sup>35</sup> The authors of the Arrowhead Report also pointed out, correctly, that the majority of uranium oxide is exchanged at long-term contract prices, not spot market prices which typically are

<sup>35</sup> Arrowhead Report, p. 80.

lower.<sup>36</sup> However, the long-term contract price, not surprisingly, typically follows the spot market prices. See Figure 2 above which shows both the spot and average new contract price moving together, significantly downward beginning at the time that the Arrowhead Center made its price projection. By the end of 2013 long-term uranium prices were at \$50 per pound, not Arrowhead's projected \$95 per pound.

In 2012 Roca Honda Resources, LLC, hired Roscoe Postle Associates (RPA) to prepare a "Technical Report on the Roca Honda Project."<sup>37</sup> That report contained an estimate of the size of the uranium resource and an economic assessment of that resource. That analysis was built around a projected market uranium price of \$75 per pound across the life of the mine. At the time of the RPA uranium price projection, RPA pointed out that the spot market price was \$51 per pound (June 2012). RPA obtained an "independent, third-party forecast for 2015 based on supply and demand projections from 2011 to 2015."<sup>38</sup> That was the source of the estimated price of \$75 for the life of the mine. By the beginning of 2014, the spot market uranium price had fallen well below the \$51 price per pound that existed at the time RPA adopted the \$75 price projection. At the end of March 2014 the spot price was less than \$35 per pound.<sup>39</sup> That is, within a year of when the spot price of uranium was projected to rise to \$75 per pound, it was actually less than half of that. See Figure 2 above.

If one compares the uranium spot market prices with the new long-term contract prices in Figure 2, there is clearly less volatility in the long-run contract prices, as one would expect. But as can be seen, the contract price of uranium oxide also declined significantly, falling from about \$95 per pound in 2007-2008 to about \$50 per pound in early 2014.<sup>40</sup> During that same period, the spot market price fell from about \$137 per pound to less than \$35 per pound. Clearly the volatility of uranium prices is not just a phenomenon of the spot market. Long-term contract prices have also changed significantly and are no longer close to the \$95 per pound level the Arrowhead Report assumed or the \$75 per pound assumed for Roca Honda by RPA, both of which high prices were projected to last for decades into the future. Those high and stable uranium price levels were necessary to support the costs of the new uranium mining that was projected.

This volatility in uranium prices has a direct impact on the employment and payroll brought to the local area and the revenues that flow to governments. High prices lead to expanded production and revenues; lower prices lead to layoffs, much smaller payrolls, and lower revenues to governments.

---

<sup>36</sup> Letter from James Peach, Arrowhead Institute, New Mexico State University, to The Honorable John Arthur Smith, New Mexico State Senator, dated October 8, 2008, p.2.

<sup>37</sup> "Report for NI 43-101 Including Updated Mineral Resource Estimate and Preliminary Economic Assessment," August 6, 2012.

<sup>38</sup> Ibid. pp. 1-4 and 1-5.

<sup>39</sup> Ux Consulting Company, LLC (UxC), March 24, 2014, spot market price of \$34.70 per pound of U3O8. <http://www.uxc.com/Default.aspx> .

<sup>40</sup> <http://www.uxc.com/review/UxCPriceChart.aspx?chart=spot-u3o8-2yr> accessed March 31, 2014.

This can be seen in Energy Fuels' response to the low uranium prices at the end of 2013 and beginning of 2014. In November of 2013 Energy Fuels issued a press release that contained projections of how it would operate during the first quarter of 2014.<sup>41</sup> Energy Fuels pointed out that the uranium spot market price at the beginning of 2014, about \$35 per pound, was "clearly well below the average economic cost to develop and produce from new uranium mines," including Energy Fuels' mines. For that reason, Energy Fuels put its development activities at its Canyon Mine in Arizona on standby. In addition Energy Fuels plans to buy uranium on the spot market to meet its contract obligations and place the Pinenut Mine, also in Arizona, on stand-by in July 2014. In addition, Energy Fuels plans to discontinue the processing of uranium ore at its White Mesa Mill beginning in August 2014. In the second half of 2015 it plans to reopen that mill but only to process alternate feed (nuclear waste) materials, *not* uranium ore. Finally, Energy Fuels expects to shut down its Arizona 1 mine in early 2014 due to the depletion of its known resources. That could potentially leave Energy Fuels with no operating uranium mines or mill by the middle of 2014. In the last quarter of 2013 Energy Fuels did not expect to make any uranium sales.<sup>42</sup>

Energy Fuels' stock price has suffered as a result of the downward trend in uranium prices. Back in April 2007, their stock peaked at \$267.50 per share. It then plunged to \$8 per share at the end of 2008. When uranium prices recovered a bit at the end of 2010 and beginning of 2011, Energy Fuels' share price rose briefly to \$79. By the end of 2013 it was trading at around \$6 per share.<sup>43</sup> That is, 98 percent of the value of its stock in early 2007 had been lost.<sup>44</sup> By the end of March 2014 the Energy Fuels stock price on the Toronto Stock Exchange was \$10.32.

Other uranium analysts have also pointed out that at uranium prices of \$40 or less per pound, the majority of uranium producers would be losing money on their uranium production and sale. There are only a few exceptions. One is where the uranium ore is unusually high grade. Cameco's McArthur River mine in northern Saskatchewan, Canada, is an example of that. Another exception is where uranium is a byproduct of the production of a different metal ore whose price makes the mining operation profitable despite the low uranium price. BHP Bilton's Olympic Dam mine in Australia is an example of that. As the investment firm of Raymond James put it, based on the cost of bringing new uranium supply online, "they [new mines] need prices north of \$70/lb. to

---

<sup>41</sup> November 14, 2013. [http://www.energyfuels.com/mobile/news/index.php?&content\\_id=277](http://www.energyfuels.com/mobile/news/index.php?&content_id=277) .

<sup>42</sup> Ibid.

<sup>43</sup> Toronto Stock Exchange, symbol EFR, 10-year chart:

[http://web.tmxmoney.com/charting.php?qm\\_page=21991&qm\\_symbol=EFR](http://web.tmxmoney.com/charting.php?qm_page=21991&qm_symbol=EFR)

<sup>44</sup> These stock prices are adjusted for the 50 to 1 conversion of existing shares for new shares on November 5, 2013. On November 4 the stock was selling for 12.5 cents per share and initially rose to \$6.36 on November 6, 2014, after the consolidation. This was done partially to allow Energy Fuels stock to be listed on the New York Stock Exchange. See Energy Fuels Corporate Update of October 31, and December 2, 2013. [http://www.energyfuels.com/mobile/news/index.php?&content\\_id=274](http://www.energyfuels.com/mobile/news/index.php?&content_id=274)

go forward. This is one of the key reasons why we feel that sub-\$50/lb. prices are unsustainable.”<sup>45</sup>

## 2. Projecting Future Nuclear Generation and Demand for Uranium

Just because existing mines and new mines like Roca Honda cannot operate at current (April 2014) uranium prices in the \$35 to \$50 range does not mean that market forces will cause those prices to rise. Recall Figure 2 above. The actual or planned shutdown of most uranium mines in the Western states and the planned shutdown of the only operating uranium mill in the U.S. confirm the assertions that a uranium mining industry is not viable at the price levels that existed in the first quarter of 2014. But those low uranium prices have continued for a half-dozen years. The near complete shutdown of uranium mining in New Mexico and most of the rest of the U.S. since 1990 has not created a shortage that has driven those prices back up. See Figure 3 below.

Many commentators continue to believe that uranium prices “are bound to increase.” But those projected price increases are tied to projected increases in the demand for uranium that, in turn, are tied to projected but uncertain events: The restarting of Japan’s and Germany’s nuclear reactors, *announced* plans to build new nuclear generators actually being realized in the addition of significant new generating capacity to the worldwide nuclear generation fleet despite the retirement of older nuclear plants, no further nuclear accidents, the deployment of new nuclear generating technologies, the stringency of environmental standards on fossil fuel plants, the relative cost of coal, natural gas, and uranium fuels, to name a few.

Electric generation with natural gas has become more attractive because of the lower capital costs, the modular nature of the gas-fired electric generating units that can be added in increments to more closely follow load growth, and the shorter permitting and construction period. In North America the development of large new natural gas supplies reduced the price of natural gas, making it a much more attractive fuel for electric generation. Natural gas also has been perceived to have fewer environmental risks associated with it. These attractive characteristics associated with natural gas, have allowed it to compete successfully in the economic dispatch of electric generators, reducing the amount of time coal-fired and nuclear plants are operated. In addition, these advantages of natural gas have allowed it to compete to replace aging coal and nuclear facilities, at least in North America

All of these uncertain conditions in uranium markets can lead to divergent future projections of the world’s reliance on nuclear energy. Consider recent projections for electric generation from nuclear-fueled plants in the U.S. In a 2013 report on alternative

---

<sup>45</sup> David Sadowski of Raymond James interviewed by George S. Mack, *The Energy Report* (8/23/2012), <http://www.theenergyreport.com/pub/na/why-uranium-prices-will-spike-in-2013-raymond-james>

projected changes in electric generation by type of fuel between 2011 and 2040, the U.S. Energy Information Administration (EIA) compared its “reference case” projections to three other independent projections. *All* of the four projections had the *share* of total U.S. electric generation coming from nuclear fuel declining 2 to 9 percent between 2011 and 2040. In addition, the EIA projection and one other projection had the actual *level* of electric generation coming from nuclear fuels increasing relative to the *level* of nuclear generation in 2011. But the other two projections had the *level* of U.S. nuclear generation going forward declining relative to its level in 2011.<sup>46</sup>

In the 2014 Annual Energy Outlook, the EIA Reference Case the electric generation from U.S. nuclear plants does rise beyond the 2011 level for 25 years into the future (2036). The capacity of the U.S. nuclear generating fleet is projected to be the same in 2040 as in 2011.<sup>47</sup>

Projecting what uranium prices will be in the future is also quite difficult, as the Arrowhead Center discovered. 2008 brought us the Great Recession and the financial crisis that slowed down economic activity and energy consumption worldwide. That made investing in nuclear plants more financially risky because of their long permitting and construction cycle. Billions of dollars of capital are potentially tied-up for many years before there is any cash flow to support the investment in nuclear generation. That high capital cost and the long permitting and construction periods led investment analysts at Moody’s to classify investments in nuclear generation a “bet-the-farm endeavor for most companies.”<sup>48</sup> In the 2013 *Annual Energy Outlook*, EIA repeated that characterization of risks associated with investments in nuclear generation.<sup>49</sup>

### 3. The Impacts of Fluctuating Uranium Prices

The shut downs of mines and mills announced by Energy Fuels, of course, will impact employment, payroll, and revenues flowing to state and local governments. The chair of the County Commission in San Juan County, UT, Bruce Adams, where the White Mesa Mill is located, commented that the shutdown of that mill would have “a big impact on our county budget, as well as the individual income of those people that work at the mill or are associated with uranium mining to bring product [uranium ore] to the mill.”

He pointed out that in 2012 the White Mesa mill paid almost a million dollars in property taxes to San Juan County. “If we lost that million dollars...it would be significant enough that we would have to look at the services that we provide, from the county to the

---

<sup>46</sup> Table 11, Comparisons of electricity projections, 2025, 2035, and 2040 (billion kilowatt-hours), pp. 96-98, *Annual Energy Outlook 2013*, DOE/EIA-0383(2013), April 2013.

<sup>47</sup> AEO 2014 Early Release Overview, EIA, December 16, 2013.

<http://www.eia.gov/forecasts/aeo/er/index.cfm> .

<sup>48</sup> R. Lum, “Moody’s: Building new nuclear a ‘bet the farm’ endeavor for most companies,” SNL Energy, July 10, 2009.

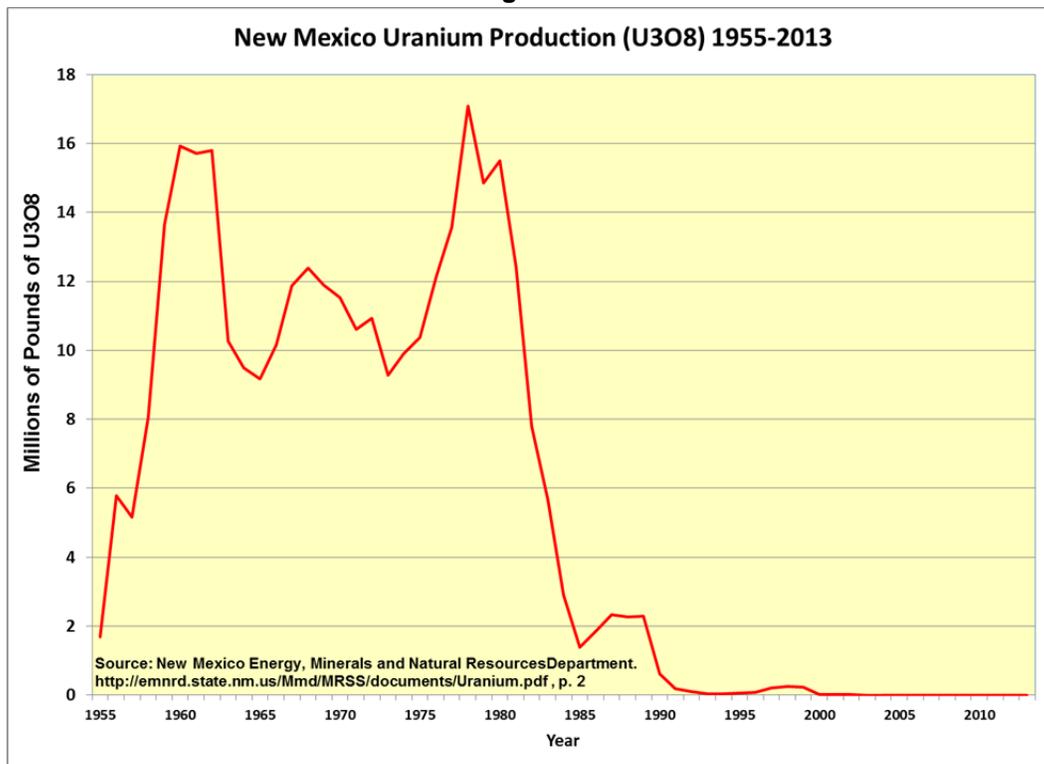
<sup>49</sup> DOE/EIA-0383(2013), April 2013, p. 46.

public...It's happened before, and it has a pretty devastating effect on these small businesses around the county that work with the mill...everything is affected by a closure of a large employer like that. And those have a multiplier effect when they happen...That multiplier goes out to everybody. It affects your school classroom sizes, and then the district has to look at their budget and what kind of cuts they have to make and it's compounded."<sup>50</sup> The past history of uranium and other metal mining in New Mexico documents the disruptive economic impacts of the instability that characterizes metal mining.

#### 4. The Unstable History of Uranium and Other Metal Mining in New Mexico

Between 1955 and 1962 New Mexico's uranium production grew rapidly and then went through several cycles of production decline, only to rise again. The decline in production that began in 1982 in New Mexico, however, ultimately led to a complete shutdown of uranium mining for over 30 years. See Figure 3 below.<sup>51</sup>

Figure 3.



<sup>50</sup>Interview by Jon Kovash, Utah Public Radio, November 25, 2013. <http://upr.org/post/plan-idle-white-mesa-mill-sends-shockwaves-through-uranium-country>

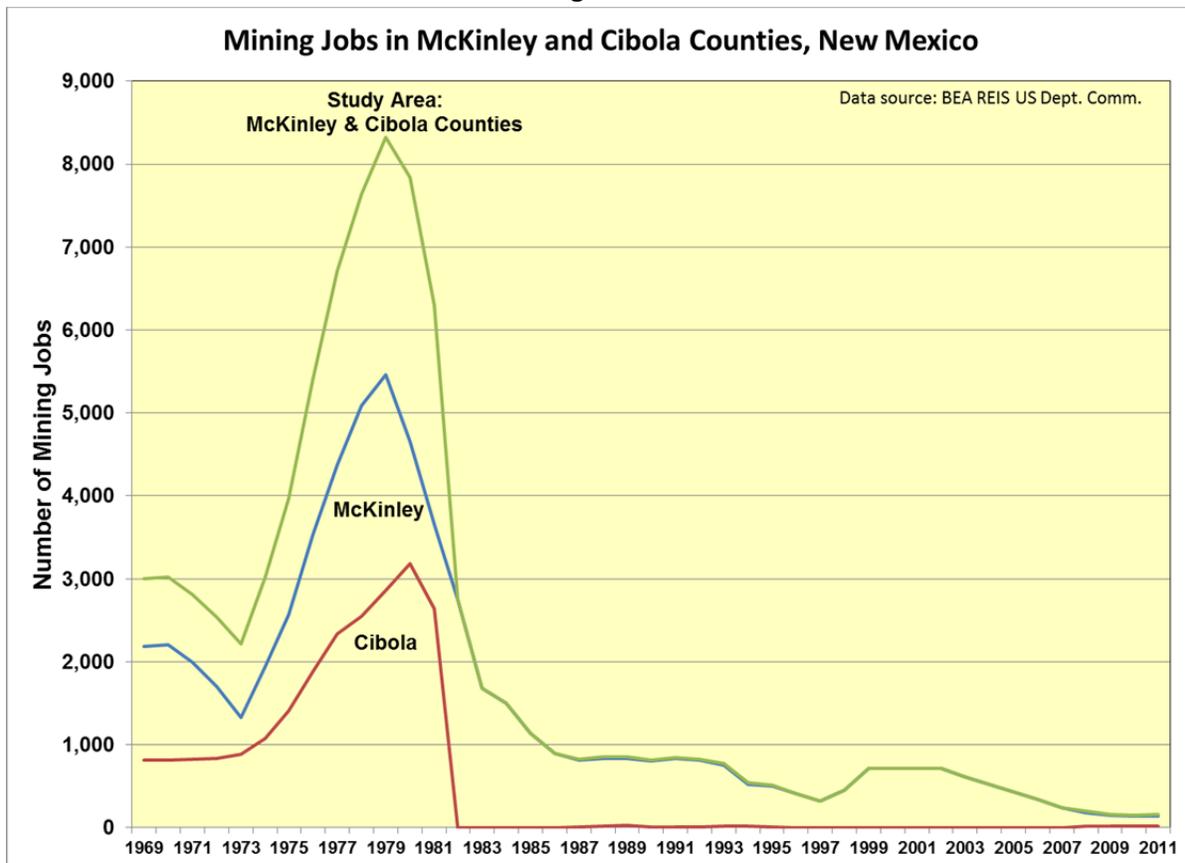
<sup>51</sup> Source: New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division <http://www.emnr.state.nm.us/Mmd/MRRS/documents/Uranium.pdf>, p.2 and personal communication with Hames Smith and John Pfeil of the NM Mining and Minerals Division.

Most of New Mexico's uranium mining and milling activities were located in McKinley and Cibola Counties. Until 1982 Cibola County was part of Valencia County. To look at the impacts of the shutdown of the uranium industry on employment in the late 1970s and early 1980s specifically in Cibola County our information is limited. After 1982 there is data specific to Cibola County.

Mining employment is a broader category of employment than just uranium mining since it includes other metal mining, coal mining, oil and gas development and production, as well as sand and gravel mining. But the changes in mining employment during this period *do* indicate the impact of the collapse of the uranium industry on local employment opportunities in McKinley and Cibola Counties.

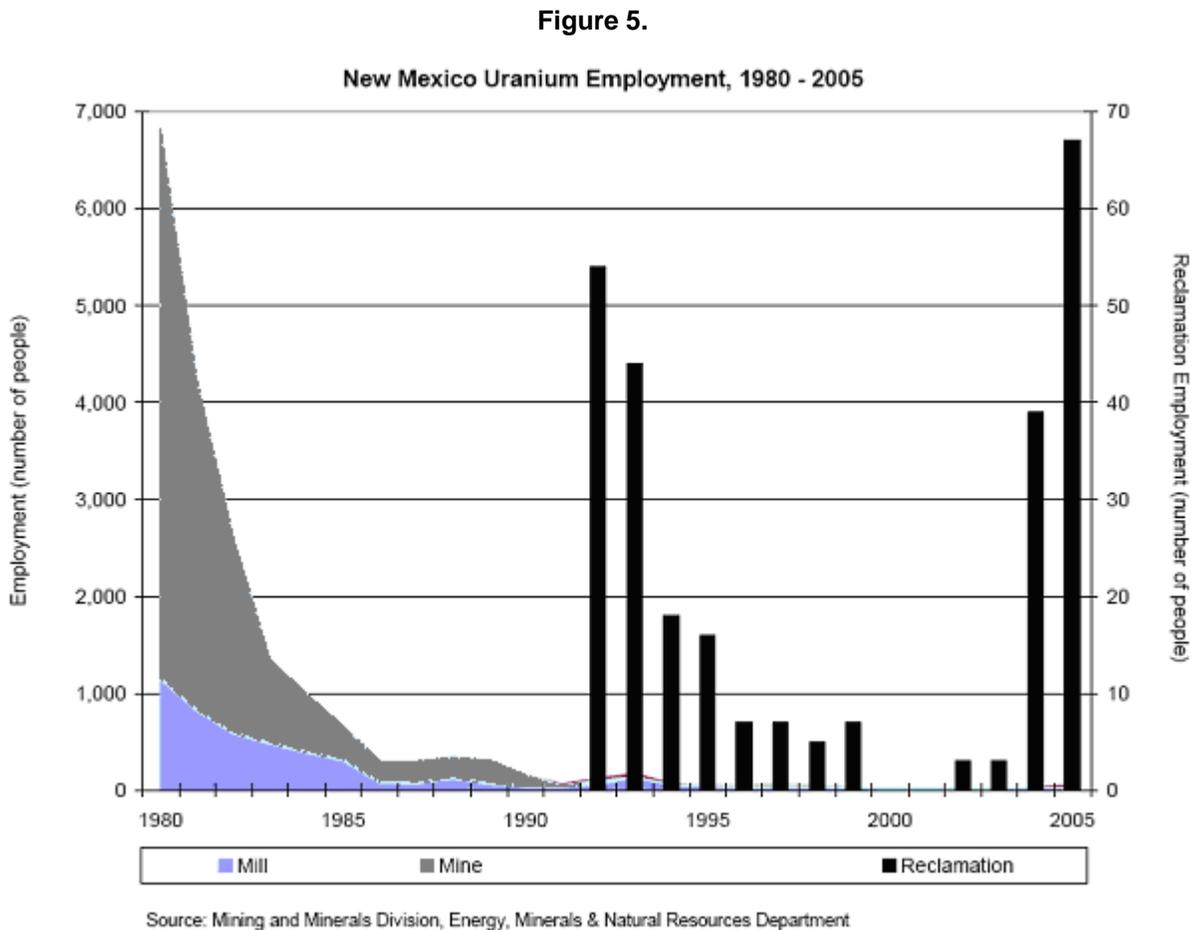
Figure 4 below shows the dramatic decline in mining employment in McKinley and Cibola Counties. Because county level data on employment by industry is not readily available before 1969, Figure 4 shows only the last cycle of boom and bust. Recall Figure 3 above. Between 1979 and 1986, 7,400 mining jobs were lost. Note that the uranium boom in these two counties, in general, lasted only eight years, 1976 to 1982, not decades.

Figure 4.



In 1980, just past the peak of New Mexico uranium production, there were 7,000 workers employed in the uranium mines and mills. By 1986, all but 300 of those jobs were gone. By 1991 there were less than 100 people employed in the uranium industry in New Mexico. Since 2000, there has been almost no employment associated with uranium mining and milling in New Mexico. See Figure 5 below.<sup>52</sup>

Figure 5 shows the collapse of employment in both uranium mines and mills as New Mexico uranium production collapsed after 1978. On a separate axis, it shows the employment in reclamation at closed mine and mill sites.



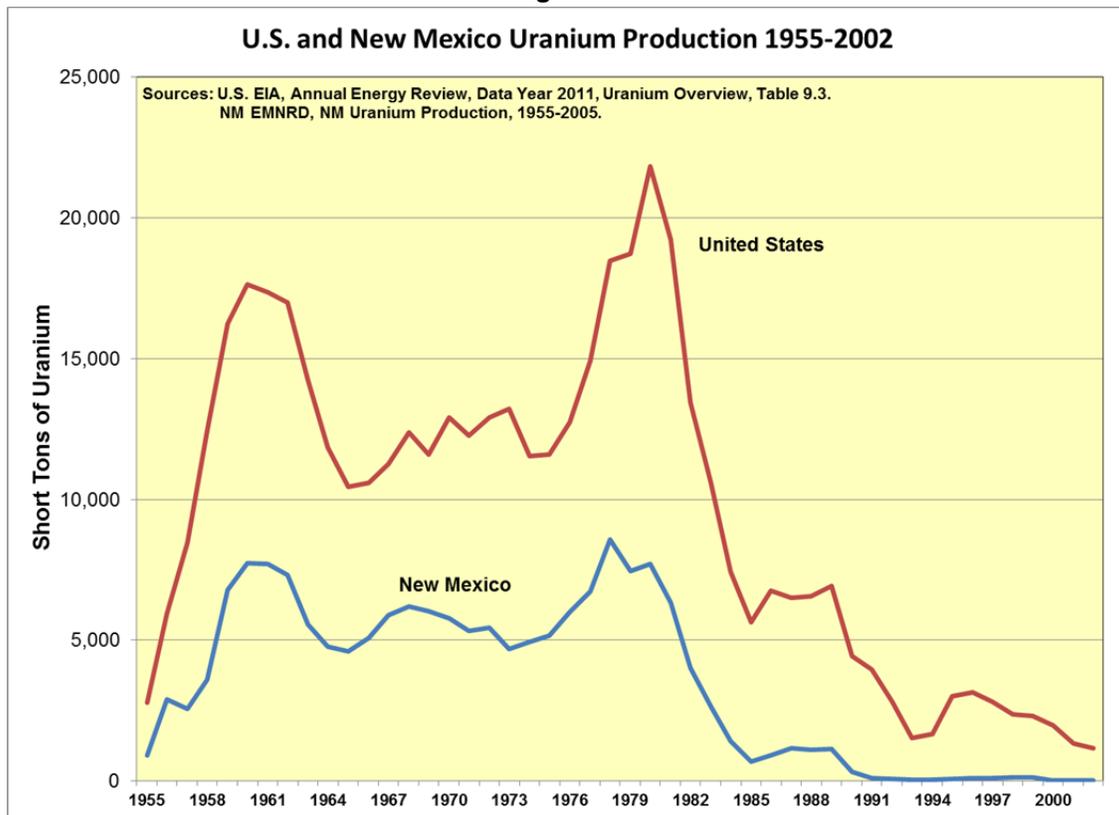
The employment of a small number of workers in reclamation activity at closed uranium mills has continued. In addition licensing and permitting activities at proposed mine sites

<sup>52</sup> <http://www.emnrd.state.nm.us/Mmd/MRRS/documents/Uranium.pdf> , p. 4. Also New Mexico Energy, Minerals and Natural Resources Department 2006 Annual Report, Table A, p. 34.

have also generated a small number of uranium-related jobs. Between 2010 and 2012 uranium mine reclamation, licensing, and permitting activities employed an average of 37 workers.<sup>53</sup> Compared to the thousands who previously had had been employed in the New Mexico uranium industry, the current employment level is effectively near zero.

The collapse of uranium production in the late 1970s and early 1980s was not just an economic problem that New Mexico faced. Uranium production nationwide collapsed dramatically too. See Figure 6 below.

**Figure 6.**



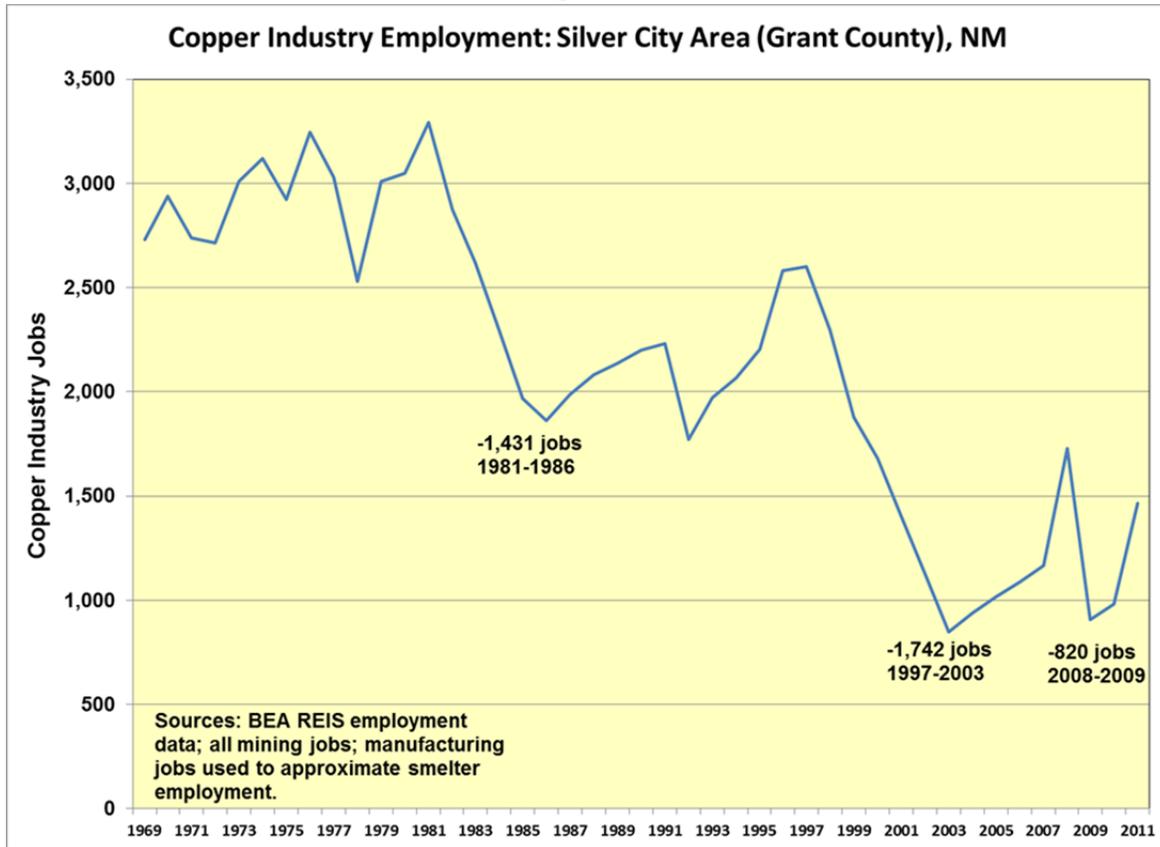
Also, it was not only uranium ore mining and processing that suffered major reverses in the early 1980s, and it was not only in New Mexico. Copper mining and smelting also largely collapsed in New Mexico. Copper industry employment in the Silver City area (Grant County), the center of the New Mexico copper industry, in 1981 totaled about 3,300.<sup>54</sup> By 2003 copper industry employment there had declined to only a quarter of what it had been in 1981. About 2,500 copper industry jobs were lost. Repeated cyclical

<sup>53</sup> NM EMNRD Annual Reports, 2010 through 2012, Table 1.

<sup>54</sup> The “copper industry” includes both mining and processing including smelting.

fluctuations in jobs have characterized the Silver City region copper industry. See Figure 7 below.

Figure 7.



Similar collapses in copper production took place in the other “copper states”: Arizona, Montana, Utah, and Michigan. The iron mining industry of Minnesota and Michigan also largely shut down between the late 1970s and mid-1980s.

Nationwide almost 60 percent of copper mining jobs were lost between 1977 and 1987, a loss of almost 20,000 jobs. By the early 2000s, the copper mining job losses had neared 80 percent of peak employment, or 30,000 jobs. In addition, many copper smelters shut down, eliminating jobs for many more thousands of copper workers. In the Silver City area of New Mexico (Grant County), about 1,400 copper jobs were lost in the early 1980s. By the early 2000s another 1,000 copper jobs had been lost. See Figure 7 above.<sup>55</sup>

<sup>55</sup> Copper prices rose steeply in the mid-2000s leading to the expansion of mining in the Silver City area and the restarting of the smelter. This led to the hiring of several hundred workers as of 2006. See Grant County quarterly employment in mining, <http://laser.state.nm.us/analyzer/>. See Arizona Daily Star, July 12, 2008. “Mining industry brightening with soaring price of copper,” Gabriela Rico.

The reason for discussing the declines in uranium and copper at the same time is to underline the fact that there are international economic forces operating that affected metal mining nation- and worldwide. As the United States' economy was increasingly integrated into the world economy, American mining and manufacturing faced increased competition from production around the world that brought metal prices down, rendering many American operations economically infeasible.

This is a familiar pattern in metal mining, including uranium mining. High commodity prices bring new mines and metal production operations on line around the globe. The resulting increase in supply then puts downward pressure on metal prices, undermining the viability of the higher cost operations. That reduction in supply helps absorb the excess production and prices stabilize. As the world economy expands, demand for metals grows and metal prices begin to rise, again stimulating interest in expanding supply. Of course, a contracting world economy can have the opposite impact: putting downward pressure on uranium prices and production.

One recent analysis of the fluctuation in uranium prices over the 2000 to 2011 described this interaction of uranium supply and demand in the following terms:<sup>56</sup>

[Uranium ] [p]rices began to rise in 2000, with significant increases during 2003–2007. Increases in the spot price of uranium during 2000–2007 were attributed to a combination of market factors: the increasing prospects for nuclear power plant construction, declining [uranium] inventories, temporary difficulties at existing and developing [uranium] mines and mills, and the entry of speculators into the uranium market. U.S. production also steadily increased from less than 2 million pounds in 2003 to more than 4.5 million pounds of U<sub>3</sub>O<sub>8</sub> in 2007, following the increase in spot prices. Uranium prices reached a high of USD 136/lb. U<sub>3</sub>O<sub>8</sub> in spring 2007, followed by a drop to prices ranging from USD 40 to USD 55 during the three years 2008–2011, as a [result of a] rapid expansion of production in Kazakhstan. Other market factors, such as the global financial crisis, added obstacles to financing uranium exploration, mine development, and construction of nuclear power plants, all of which contributed to the “cooling” of the uranium market. Prices surged again during the last quarter of 2010 and in early 2011, in response to China’s announced plans for and its moves to secure uranium contracts for large planned increases in nuclear power.

---

<http://www.azstarnet.com/sn/biz-topheadlines/247937.php> It estimates that 2,100 jobs were added in the copper industry between 2006 and 2007 across New Mexico. The Grant County data shows 712 mining jobs added between 2005 and 2008. But then copper industry jobs tumbled downward again by 820 jobs.

<sup>56</sup>Susan Hall and Margaret Coleman, U.S.G.S. Scientific Investigations Report 2012-5239.

<http://pubs.usgs.gov/sir/2012/5239/> , p. 8-9.

As pointed out above (Figure 2) and as discussed further below (Figure 9), the mini-peak in uranium prices in 2011 referred to at the end of the quote above was also short lived as uranium prices returned to a downward drift through 2013.

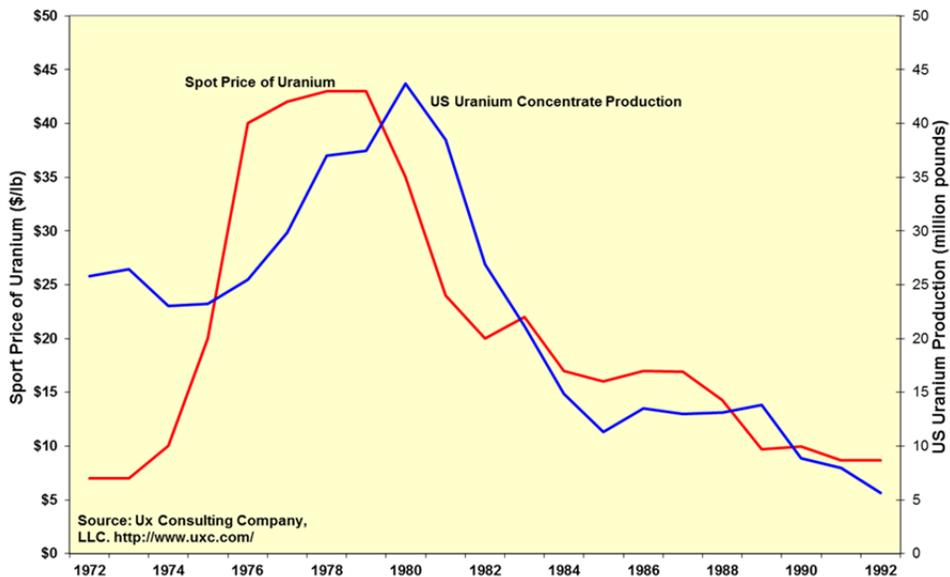
A recent “Critical Analysis of World Uranium Resources” carried out by the U.S. Geological Survey (USGS) and U.S. Energy Information Administration (EIA) described this lag between changes in demand and supply in the following way:<sup>57</sup>

...the price of yellowcake hinges on world demand. Increases in uranium price encourage exploration for primary resources, thereby increasing supply. Mineability of an individual deposit is influenced by the delineation of identified RAR [Reasonably Assured Resources], the duration of the permitting process, the costs to mine and mill the product, the construction of infrastructure, and the ability of mine owners to raise capital to finance mining projects. Current estimates show the lag time from discovery to production ranges from 15 to 20 years.

The interaction between uranium price and production can be seen in the expansion and then dramatic contraction in uranium production in the United States and New Mexico in the 1970s and 1980s. As uranium prices rose, so did production until supply exceeded demand. When uranium prices plummeted, so did the level of uranium production and employment in the industry. See Figure 8 below.

**Figure 8.**

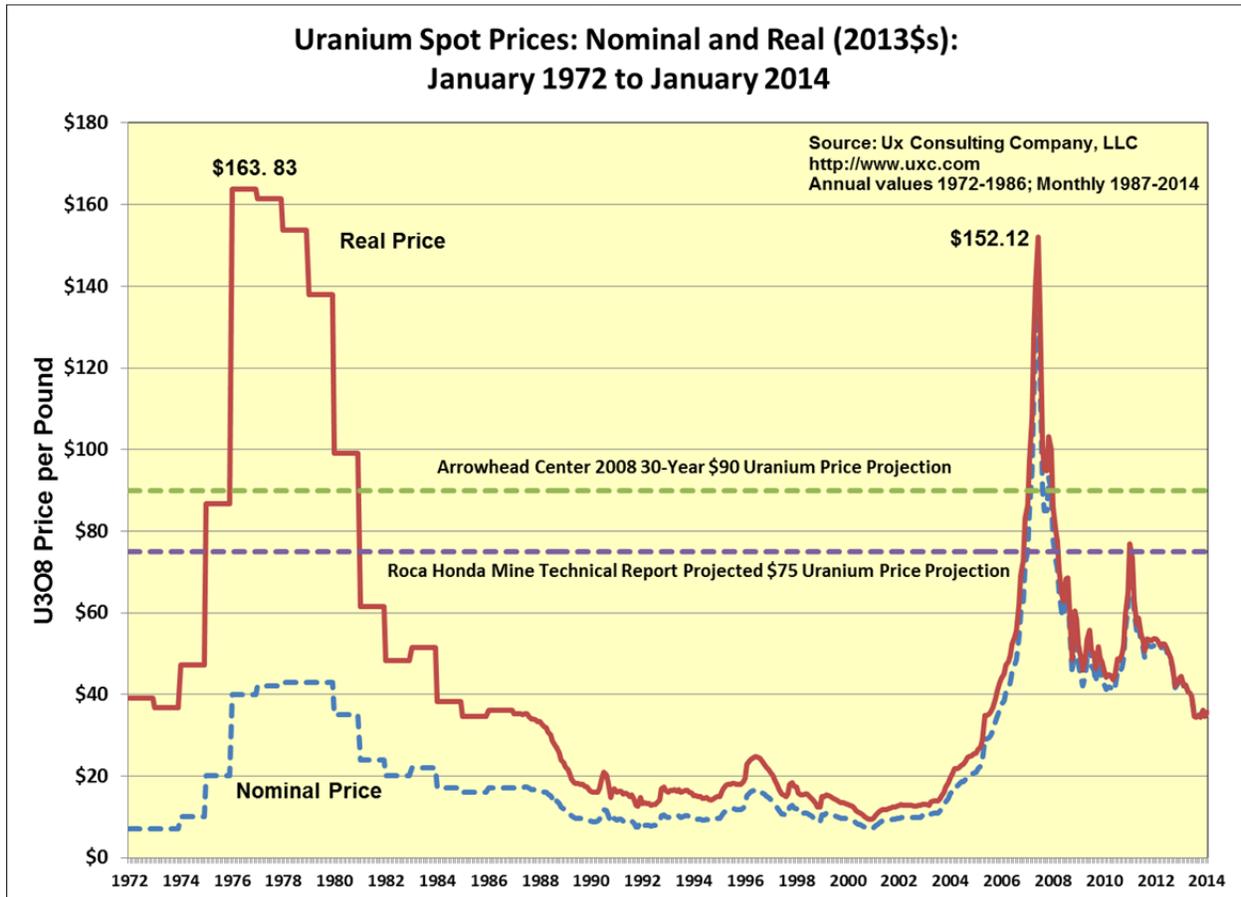
U. S. Uranium Prices and Production: 1972-1992



<sup>57</sup> Ibid , p. 2.

It is the volatility of metal prices that leads to instability in employment and payroll in the metal mining and processing industry. It is important to keep that instability in mind when evaluating uranium mining companies' projections of high and stable uranium prices over the entire life of a mine and/or mill, e.g. the projection for Roca Honda of uranium prices of \$75 per pound for the life of the mine.

Figure 9.



If uranium prices are adjusted for inflation (i.e. converted to “real” prices, dollars of constant purchasing power), the high uranium prices in 2007-2008 that triggered talk of a uranium renaissance in New Mexico were not unprecedented. Uranium prices were as high as or higher than those in the 1970s at the time of the previous uranium boom in New Mexico, just before the bust of the 1980s. See Figure 9 above. Just as real uranium prices tumbled downward after that 1976 peak, the same thing happened after the brief peak uranium prices in 2007.

Also note that the real price of uranium was at or above the \$75 to \$90 real price range during the uranium boom of the 1970s for only six years. During the 2007-2008 uranium

price spike, real uranium prices were at or above those levels for only 15 months. Yet the Roca Honda mine projects uranium prices at the \$75 level for the entire life of the mine. The earlier Arrowhead Report projected that uranium prices would be \$90 or more for 30 years into the future.<sup>58</sup> Both of these uranium price projections were based on the temporary high uranium prices at the time that the respective reports were being written, 2007-2008 for the Arrowhead Report and 2011-2012 for the Roca Honda Technical Report. Those particular momentarily high prices were simply assumed to be permanent. Clearly the 40-year history of real uranium prices does not support such optimism about how high and how stable uranium prices will be in the future.

The Arrowhead Center's projection that high levels of uranium industry employment, payrolls, and revenue flows to local and state governments would remain stable assumes that high uranium prices will be achieved and then not change for decades into the future. Roca Honda Resources has projected that the proposed mine will operate at a constant level of output, employment, and payroll throughout its life. The Arrowhead Center's 2008 projection of a uranium industry revival in New Mexico relied on an expected thirty year life for its projected new set of uranium mines and mills in New Mexico.

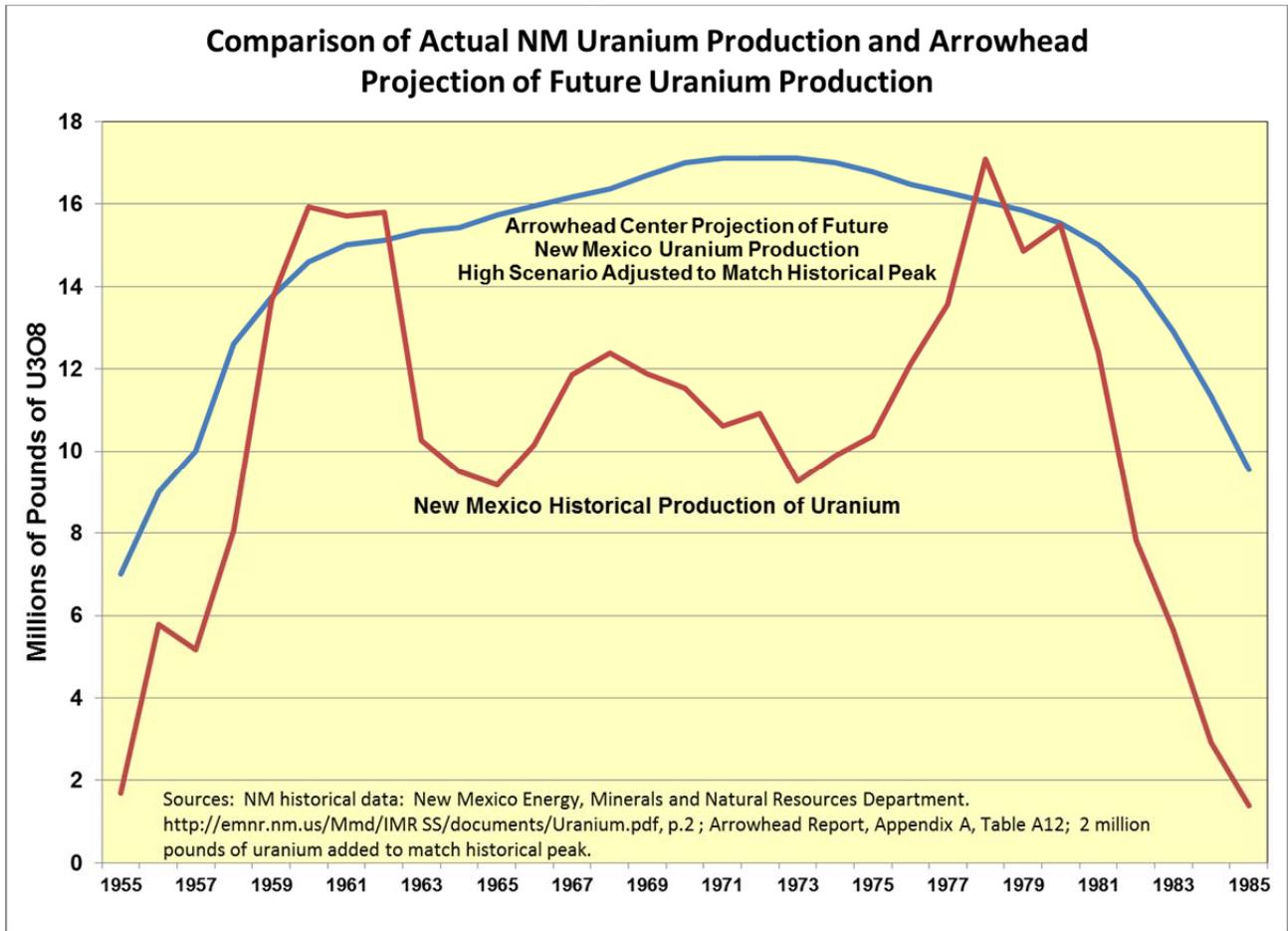
Figure 10 below shows that the Arrowhead Center projected a ramping up of uranium production in New Mexico, followed by a relatively stable level of production for 20 years before production declined. Figure 10 also compares that projection with what actually happened to New Mexico uranium production between 1955 and 1985. Historical reality was much more unstable than the Arrowhead Center's projection. Uranium production fell 42 percent between 1962 and 1965. It recovered somewhat and then fell again by 25 percent between 1968 and 1973. After 1978 New Mexico uranium production fell 92 percent by 1985. Since the Arrowhead Center assumed that employment at uranium mines and mills would be directly proportional to output, employment and payroll would be unstable in exactly the way that uranium production was. In addition, since revenues to state and local governments are tied to the value of uranium production and the expenditures of uranium workers, those revenues to governments would be unstable too. One analysis of the impact of the fluctuation metal mine production, employment and payroll on local communities described this instability and disruption as "riding the resource roller coaster."<sup>59</sup> The historical New Mexico uranium production line in Figure 10 certainly resembles a roller-coaster.

---

<sup>58</sup> Op. cit. Arrowhead Report, p. 39.

<sup>59</sup> ***Riding the Resource Roller Coaster: a Comparison of Socioeconomic Well-Being in Two Midwestern Metal-Mining Communities***, Lisa J. Wilson, Ph.D. dissertation University of Wisconsin-Madison, December 2001. Also, "Riding the Resource Roller Coaster: Understanding Socioeconomic Differences between Mining Communities," Lisa J. Wilson, ***Rural Sociology*** 60(2):261-281, 2004.

Figure 10.



## 5. The Future Adequacy of Uranium Supplies

There is no reason to believe that uranium prices will return to the peak levels of 1975-1980 or 2007-2008 in the next 10 to 20 years *and stay there indefinitely*. Known uranium ore deposits exist throughout the world. The U.S. Geological Survey in cooperation with the U.S. Energy Information Administration carried out a “Critical Analysis of World Uranium Resources” in 2012.<sup>60</sup> That study reviewed the uranium resources of almost 50 nations around the world.<sup>61</sup> Drawing on uranium resource estimates of the Nuclear Energy Agency (NEA) and International Atomic Energy Agency (IAEA), it concluded that “reasonably assured uranium resources,” and “inferred

<sup>60</sup> Susan Hall and Margaret Coleman, U.S.G.S. Scientific Investigations Report 2012-5239. <http://pubs.usgs.gov/sir/2012/5239/>

<sup>61</sup> Ibid. Table 5. These resource estimates came from the NEA-IAEA 2009 *Red Book*.

uranium resources,” around the world “would satisfy current demand for 70 years.<sup>62</sup> The USGS-EIA analysis had a narrow focus:

“The NEA takes a more cautious view of the timely development of nuclear fuel supplies. In the 2009 “Red Book,” the NEA forecasts adequate Identified Resources (Reasonably Assured Resource plus Inferred Resources) to supply reactors for the next 100 years, if 2008 consumption rates...are projected into the future. This forecast does not take into account projected growth in [nuclear generating] capacity. If all conventional resources are included (Identified Resources plus Speculative and Prognosticated Resources), then the supply would last 300 years, through 2410, using the 2008 consumption rate.”<sup>63</sup>

Technological advances in nuclear reactor design could further enlarge the effective available supply by increasing the efficiency with which energy is extracted from the nuclear fuel. Currently only a small fraction of the total energy contained in uranium fuel is used.<sup>64</sup> The rest remains in the highly radioactive waste materials that have to be carefully disposed of at considerable cost and risk.

The conventional supplies of uranium ore available for development around the world are extensive. The United States has a relatively small part of the total uranium reserves, about 7 percent.<sup>65</sup> Australia has about a quarter and Kazakhstan almost a fifth of the uranium reserves. Other countries around the world, including Canada (currently, the largest uranium producer in the world), South Africa, Namibia, and Brazil, all have as much or more uranium reserves as does the United States. When the reserves are classified by quality and cost of extraction, the United States reserves are inferior to those of most of those other nations.<sup>66</sup>

Furthermore, extensive uranium supplies also exist in such “secondary” sources as highly enriched uranium in surplus nuclear warheads, “tails” from uranium enrichment processes, and government and commercial inventories.<sup>67</sup> The USGS-EIA Critical Analysis of World Uranium Resources estimates that 25 percent of the world uranium

---

<sup>62</sup> Ibid. p. 33. The “inferred resources” are less certain and the quantities of uranium associated with them could turn out to be substantially different from current estimates.

<sup>63</sup> Ibid. p. 34.

<sup>64</sup> This “new generation” of nuclear reactors faces serious problems, however. Their fuel cycle increases the opportunity to divert weapons-grade material and aggravate nuclear weapons proliferation problems. In addition, these reactors have faced a variety of technical difficulties that have made their operation unreliable.

<sup>65</sup> The U.S. has 7.49 percent of the “Reasonably Assured Resources” reported in the 2009 Red Book (NEA–IAEA, 2010).“ Op. Cit. USGS-EIA Critical Analysis of World Uranium Resources Table 5, page 25.

<sup>66</sup> Op. Cit. USGS Critical Analysis, Table 5. That table is based on the 2009 NEA-IAEA *Red Book*.

<sup>67</sup> “Secondary Supplies: Future Friend or Foe, James C. Cornell, World Nuclear Association 2005 Symposium. <http://213.198.118.156/sym/authidx.htm> .

supply in 2010 came from such secondary sources.<sup>68</sup> While current policies and laws in the U.S. restrict the volume of uranium that can be released from government weapons-grade stockpiles or “blended” with uranium to make reactor fuel, changes in government policies could free up substantial quantities of uranium to offset or replace the need for new mining here and abroad.<sup>69</sup> In fact, it has been the use of those “politically controlled” secondary sources of uranium that have kept the price of uranium so low that most uranium mines in the United States could not operate during the 1990-2013 period. These secondary sources will continue to impact the viability of new uranium mines in the United States for the foreseeable future despite the fact that the Russia will no longer be selling recycled weapons-grade uranium solely to the U.S. But that nuclear material like that stockpiled in the U.S. will remain part of the world uranium supply.

In conclusion, uranium mining, like other metal mining, tends to be an unstable industry prone to “boom and bust.” New Mexico knows this well since it has lived through one major uranium boom and bust as well as a more recent flurry of enthusiasm for a return to uranium mining and processing when uranium prices temporarily spiked in 2008 and again in 2011 only to return to a declining trend. New Mexico has also had the same experience with copper mining.

Mining industry instability makes the potential employment, payrolls, royalties, and taxes associated with uranium mining uncertain. The expected value of those positive projected economic impacts would be lower if future uranium prices include long periods of much lower prices as they have in the past.

New uranium mines and mills in New Mexico will be competing with other uranium sources in the United States and around the world. Should Kazakhstan and Canada bring relatively large lower-cost increments of supply on line, the rush to expand production from existing and new mines and from secondary sources will have the effect of lowering prices as supplies increase. To the extent that New Mexico joins in the the rush to rebuild an extensive uranium mining infrastructure, it may well ride the uranium mining “roller coaster” once again<sup>70</sup>.

This is *not* to say that world uranium supplies will always and instantaneously be available to the nuclear power industry at a low price. As discussed above, that is not how metal commodity markets usually work. One can expect periods when uranium mining and processing do not expand as quickly as the demand for uranium is growing which will, in turn, lead to higher prices for extended periods of time. Although higher prices will encourage expanded mining and processing, there can be significant lags

---

<sup>68</sup> Op.cit. Figure 6, p. 7.

<sup>69</sup> Ibid. As with any nuclear technology, including uranium extraction and enrichment, down-blending presents a risk of nuclear proliferation.

<sup>70</sup> *Riding the Resource Roller Coaster: A Comparison of Socioeconomic Well-being in Two Midwestern Metal-Mining Communities*, Lisa J. Wilson, Ph.D. dissertation, sociology, University of Wisconsin-Madison, 2001. Also, “Riding the Resource Roller Coaster: Understanding Socioeconomic Differences between Mining Communities,” Lisa J. Wilson, *Rural Sociology* 69(2): 261-281, 2004.

between such price signals and the development of new supply sources as illustrated in Figure 9 above.

As stated in the USGS-EIA Critical Analysis of World Uranium Resources:<sup>71</sup>

Production of [uranium resources] in both operating and developing uranium mines is subject to uncertainties caused by technical, legal, regulator, and financial challenges that combined to create long timelines between deposit discovery and mine production. This analysis indicates that mine development is proceeding too slowly to fully meet requirements for an expanded nuclear power reactor fleet in the near future (to 2035), and unless adequate secondary or unconventional resources can be identified, imbalances in supply and demand may occur.

Of course, the projection of the “requirements for an expanded nuclear power reactor fleet” is also uncertain. The world’s reliance on nuclear power in the future will depend on a broad array of factors such as the cost of generating electricity with alternative sources of energy, the safety and reliability of the nuclear generating fleet, and the successful deployment of new nuclear technologies that reduce the modular size, cost, and time to bring a nuclear facility on line.

If there is a “shortage” in uranium supplies that drives uranium prices upward, the accompanying expansion in uranium supply is likely to “over-shoot” the demand or the demand may tumble because of the higher production costs or because of a nuclear reactor accident, or some other change in uranium market conditions and uranium prices will tumble downward again. That is, uranium price instability will continue and that price instability will lead to instability in uranium industry employment, payroll, and payments to governments, just as it has in the past.

In the previous section of this report, we discussed the likely size of the positive economic impacts associated with the proposed Roca Honda Mine. In this Section II we discussed the size of those positive impacts in relation to an unstable uranium market. In the following Section III, we combine our previous discussion with a description of the actual rural economy in which the Roca Honda mine would be embedded, the economies of McKinley and Cibola Counties. That will allow us to evaluate the relative size of the local impact from the proposed Roca Honda mine.

---

<sup>71</sup> Op. cit. p. 1.

### III. The Local Economy in the Roca Honda Mine Study Area

#### 1. Introduction

The 50-mile-wide Grants Mineral Belt, which stretches 120 miles from just west of Albuquerque to the Arizona border near Window Rock, was the source of more than 30 percent of the uranium produced in the United States between 1948 and 2002.<sup>72</sup> Grants, the seat of Cibola County, and Gallup, the seat of McKinley County, are the largest cities in that mineralized area. For that reason, we have used McKinley and Cibola Counties together as the local study area that would be impacted by the proposed Roca Honda Mine. Both the U.S. Forest Service DEIS and Arrowhead Center economic impact analysis sponsored by Roca Honda Resources also used the same two-county study area focus.

Cibola County was not created until 1982 when the western part of Valencia County became a separate county. That means that separate economic data does not exist for Cibola County during the uranium boom of the 1970s and the uranium bust of the early 1980s. As a result, we cannot track the boom and bust in Cibola County the way we can in McKinley County.

In order to put the estimated economic impacts of the operation of the proposed Roca Honda Mine into a context in which their relative importance can be evaluated, it is necessary to understand the local economy in which that mine would be embedded. That local economy, of course, went through the uranium boom of the 1970s and the uranium bust of the first half of the 1980s that created and then destroyed about 7,500 mining jobs. This is shown in Figure 11 below which reproduces Figure 4 from above. The uranium mining boom of the 1970s created 6,200 new mining jobs in the two-county study area.<sup>73</sup> At its peak at the end of the 1970s, mining was the source of 21 percent of all jobs in that study area. In McKinley County, almost a quarter of all jobs were in mining. That changed dramatically as the uranium boom collapsed. Mining employment fell from 8,400 in 1979 to 500 in 1997. In dollars of constant 2012 purchasing power, mining was the source of \$750 million in payroll at its 1979 peak in the Cibola-McKinley study area, representing over 40 percent of all payrolls being generated by businesses in the study area. A decade later in 1989, mining was the source of about \$82 million in payroll about 8 percent of the study area total.<sup>74</sup>

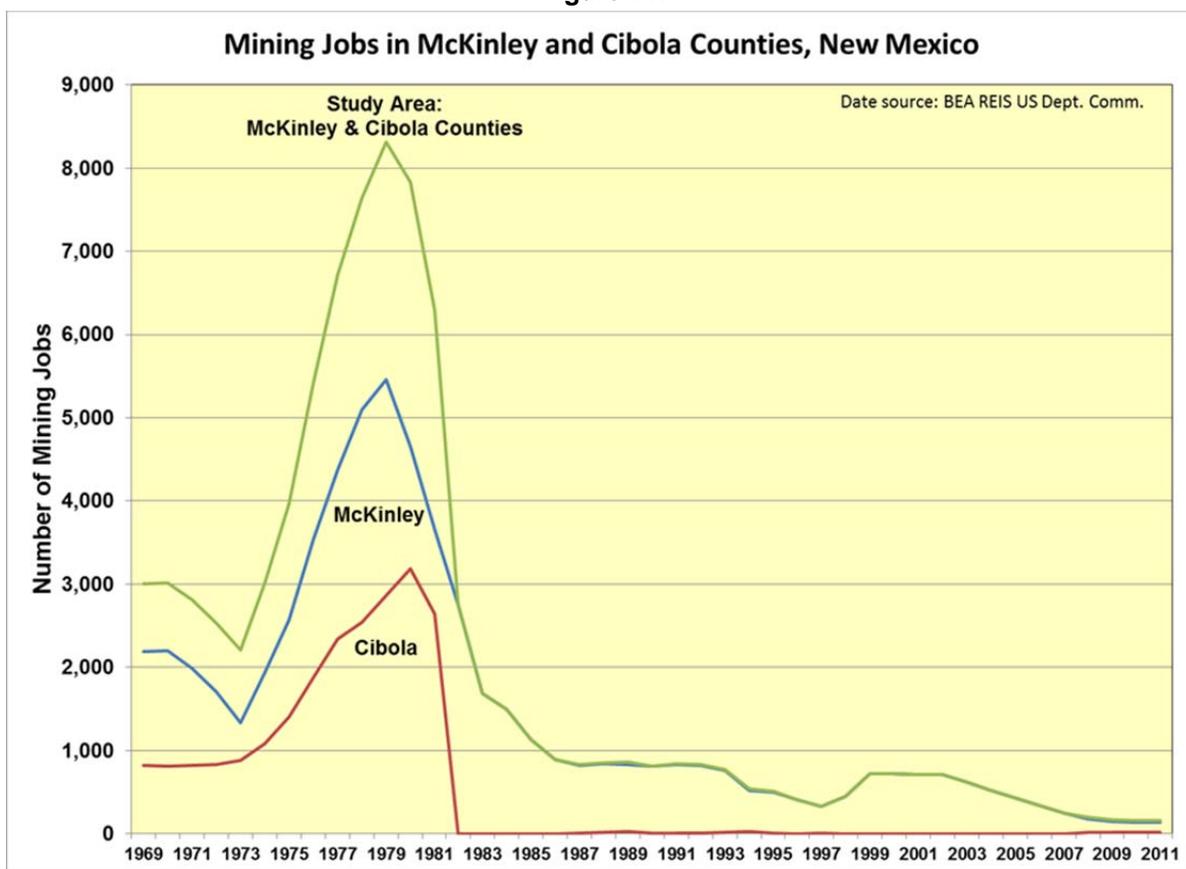
---

<sup>72</sup> McLemore, V.T. Uranium Resources in New Mexico, New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, SME Preprint Annual Meeting 2007, p. 1.

<sup>73</sup> For the boom period, Valencia and Cibola Counties were still one county. Almost all of the mining in the larger pre-1982 Valencia County was in the western part of the county that in 1982 became Cibola County. In 1982, with the split-off of Cibola County, the mine employment in Valencia County fell from 2,700 in 1981 to 59 in 1982. Mine employment in the Cibola-McKinley study area in 1973 was 2,124 and in 1979 it was 8,320, for a gain of 6,196 mining jobs.

<sup>74</sup> Real 2012 \$. We are using the mining employment and payroll of the pre-division Valencia County as a close approximation of the mining employment and payroll of the area that was to become Cibola

Figure 11.



One might have predicted that these dramatic changes in mining employment and payroll would have had a profoundly negative effect on the rest of the non-mining local economy given that export-oriented economic activities such as mining are, in the conventional wisdom, assumed to drive the rest of the local economy. But, as the data discussed and displayed in the following pages demonstrate, quite the opposite was true.

The local economies in McKinley and Cibola Counties have had about 30 years to digest the uranium boom and bust cycle and adjust to an economy that is not built around mining. The local economy's evolution in the aftermath of the boom and bust period provides important information about the impact that a renewal of uranium mining would have on the region.

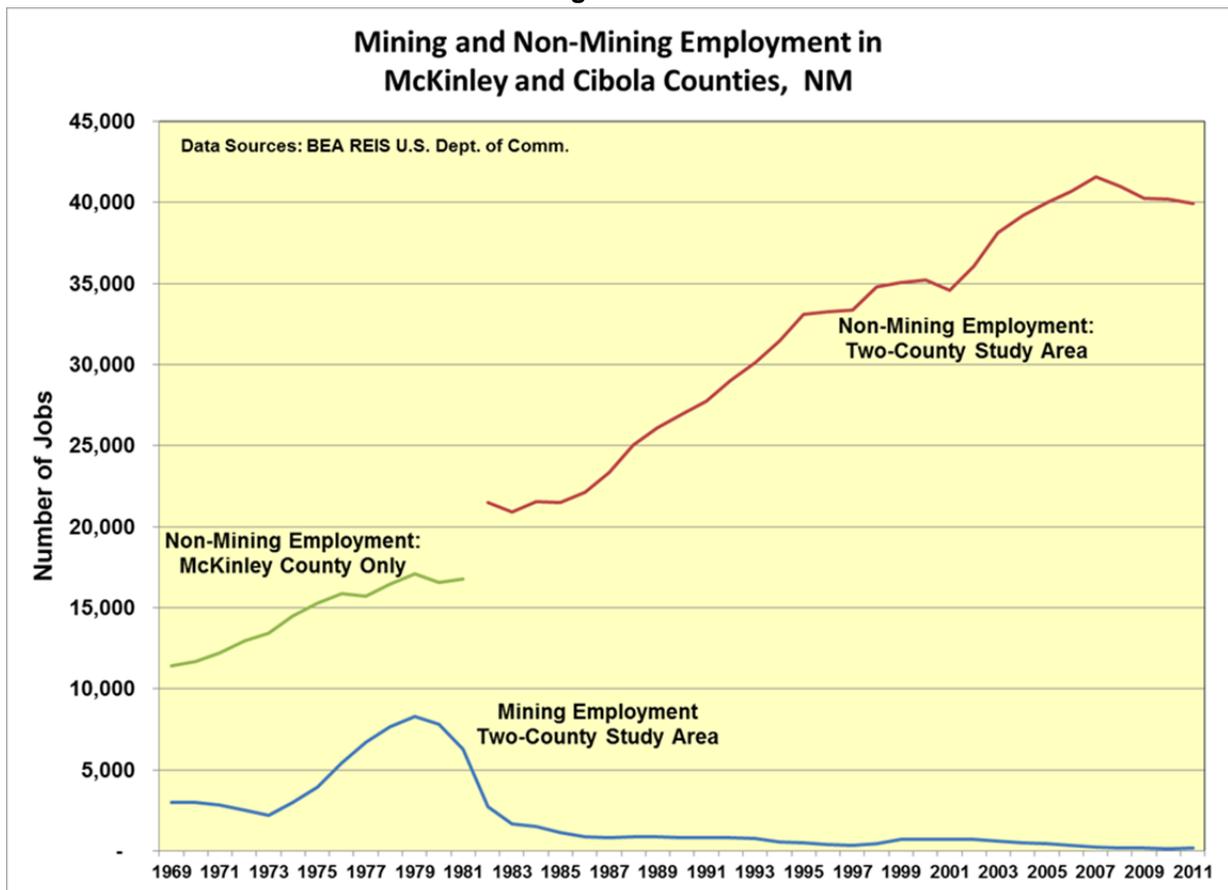
---

County. McKinley County has a significant coal industry. That explains the ongoing employment in mining after uranium mining virtually ceased, reducing mining in Cibola County to near zero.

## 2. The Economic Recovery of the McKinley-Cibola Study Area from the Uranium Bust

The ongoing growth in jobs in the McKinley-Cibola study area after the uranium bust of the early 1980s in economic sectors outside of the mining industries suggests that there were significant sources of local economic vitality in the non-mining sectors of the economy in that area that quickly offset the dramatic loss of uranium mining jobs. Between the end of the uranium bust in 1983 and the year before the onset of the Great Recession (2007), the number of jobs outside of the mining sectors in the two-county study area doubled, adding about 21,000 jobs despite the ongoing decline in total mining employment. See Figure 12 below.

Figure 12.<sup>75</sup>



<sup>75</sup> The gap in the data between 1981 and 1982 in Figure 12 is due to the fact that Cibola County did not come into existence until 1982. As a result, between 1981 and 1982 the non-mining employment in Cibola County was added to that in McKinley County to make up our two-county study area. The gap is the non-mining employment in Cibola County.

It is important to understand that the sources of local economic vitality and well-being that were *not* tied to uranium mining that allowed this local economic expansion to take place despite the almost complete loss of the mining sector.

**A. The Impact of the Commuting Patterns of Miners and Other Workers**

Many workers who commuted into McKinley County during the local uranium boom came from the western part of Valencia County that is now Cibola County. This means that much of the income earned in uranium jobs in McKinley County flowed out of that county into a larger economic area. As a result Cibola and McKinley Counties were economically linked.

Figure 13.

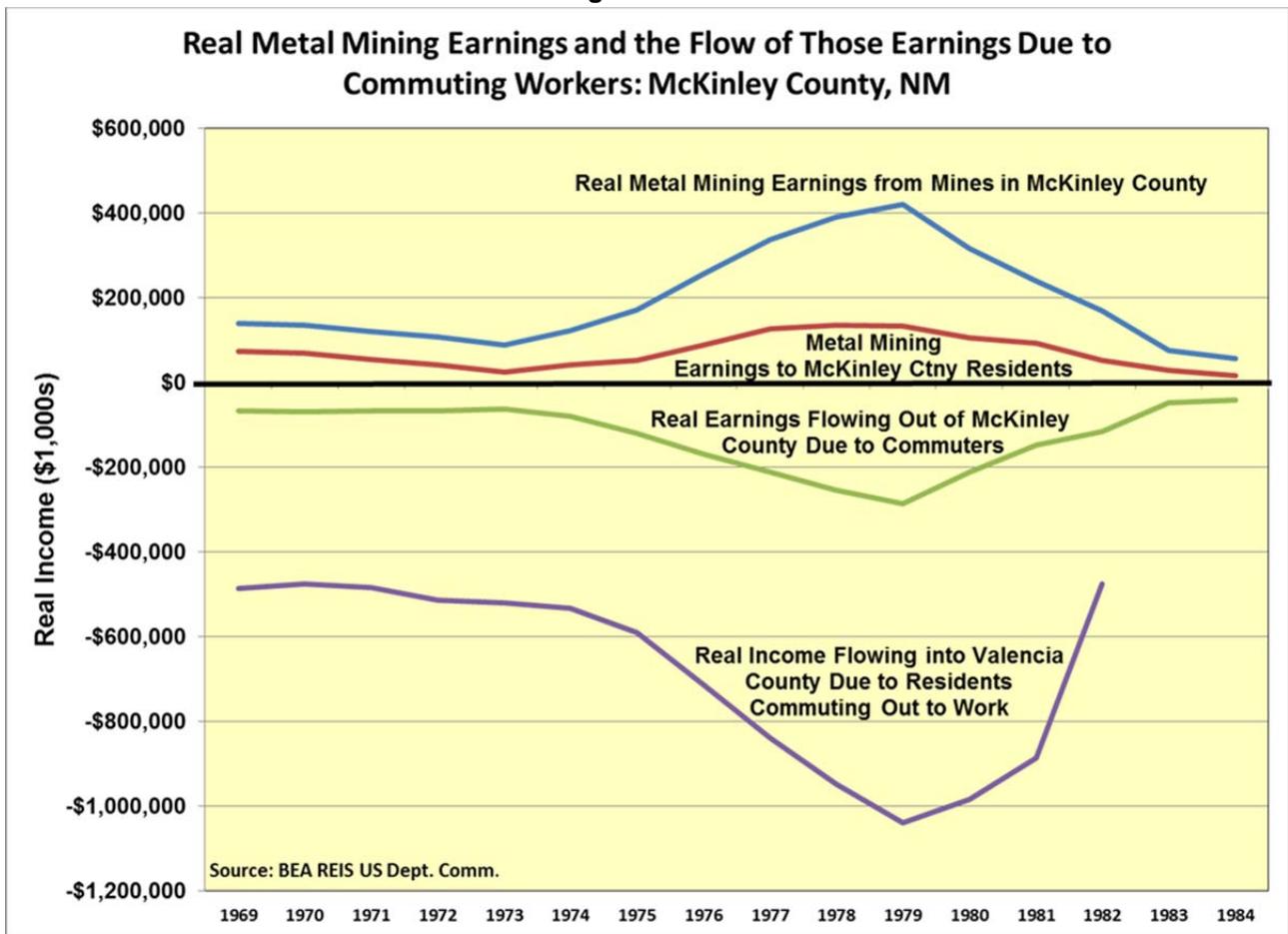


Figure 13 above shows the impact of workers commuting into McKinley County during the uranium boom. The data indicate that the McKinley County uranium mining workforce during the 1975-1985 boom, in general, did not live in McKinley County. As a

consequence, the equivalent of two-thirds of the earnings of the metal miners in McKinley County flowed out of that county. Figure 13 also shows the significant flow of labor income into what was then Valencia County from jobs outside of that county<sup>76</sup>. The phenomenon of mine workers commuting to jobs in other counties is not unusual. Miners represent a very mobile workforce. The relatively high pay in mining often justifies long commutes or temporary relocation while maintaining a household elsewhere. This situation, however, also means that much of the value created by the mining activity flows elsewhere.

### ***B. The Growth of Wages and Personal Income***

The stability and continuing growth of jobs in the two-county study area was impressive after the area had suffered such a large economic shock in terms of lost uranium jobs and payroll.

One part of the explanation for the stability of local employment outside of mining in the face of such a large shock is that there appears to have been few, if any, “ripple” or “multiplier” impacts associated with the expansion and subsequent contraction of the uranium industry in Cibola-McKinley study area. The real earnings and other sources of personal income not directly associated with mining *grew* during the bust in McKinley County. There was a very modest decline in the growth of other sources of income *before* the uranium decline began but there was ongoing growth during and after the bust. See Figure 14 below for the experience in McKinley County.

Note that as the payroll associated with mining in McKinley County fell steeply after 1979, real wage income in the other sectors of the economy *increased* as did real personal income from non-mining sources. That increase in real income being generated in McKinley County continued from 1979 until the effects of the Great Recession began to be felt in the study area after 2007. For most of those almost 30 years, real payroll in mining continued to decline.

Since Cibola County was not formed until after the uranium bust was well underway, we can only analyze data from after 1982 on the growth of wages and other personal income there. The ongoing growth in non-mining real wages and income in the two-county study area after 1982 is shown in Figure 15 below.

---

<sup>76</sup> The eastern part of Valencia County serves as a bedroom community for the Albuquerque metro area. That is one of the reasons that there is such a large flow of labor income into Valencia from Valencia residents that commute out to work.

Figure 14.

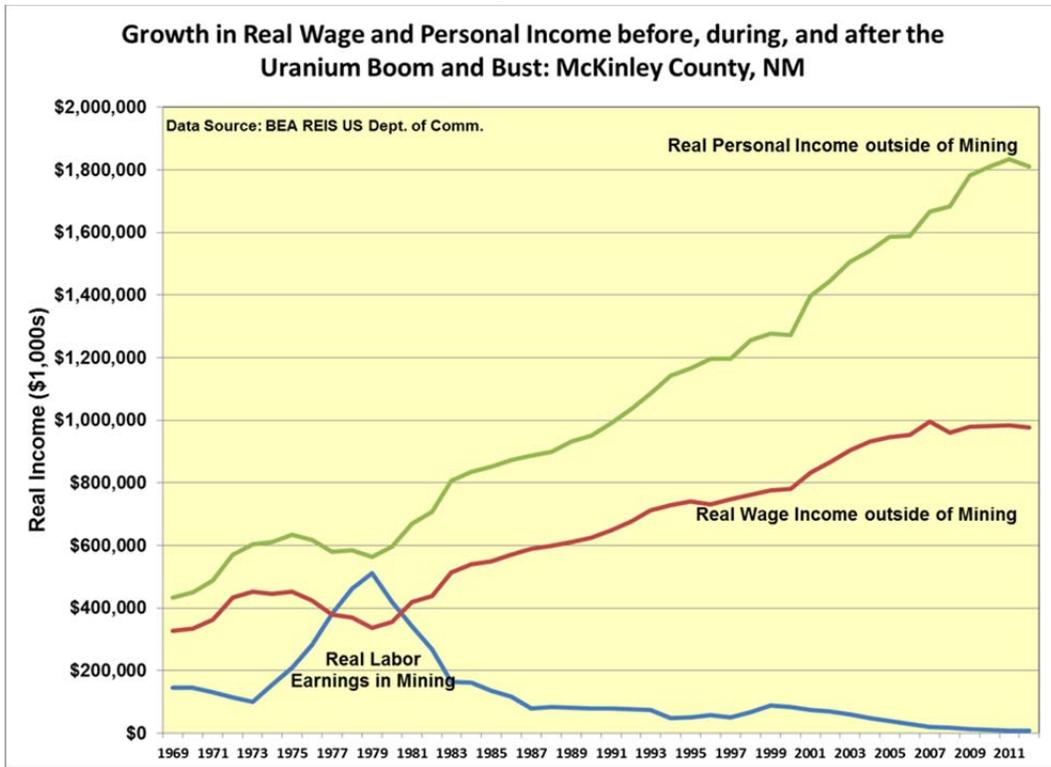
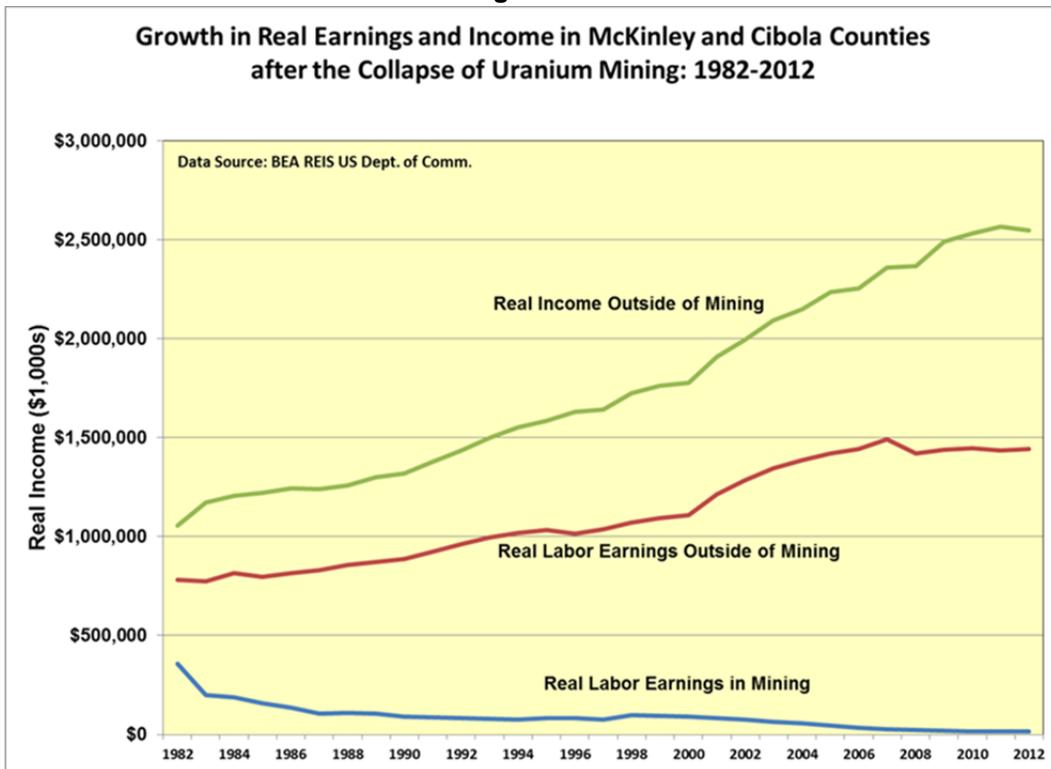


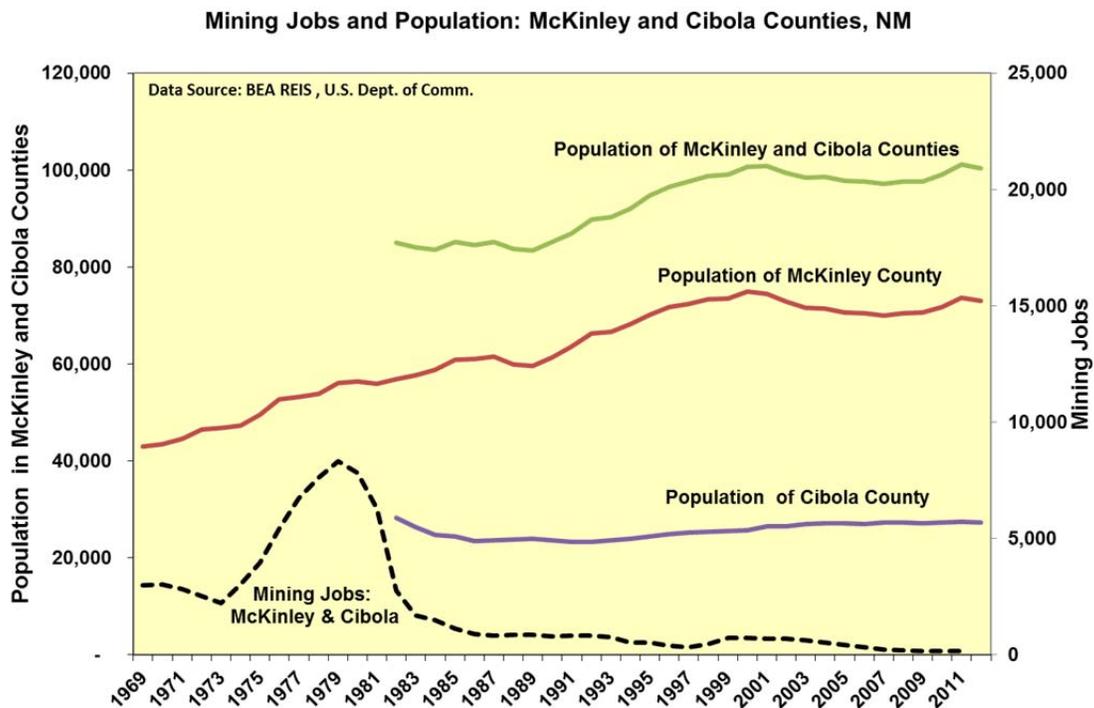
Figure 15.



### C. Changes in Population

Despite the loss of a fifth of total jobs and 40 percent of total labor earnings when the uranium industry collapsed in the early 1980, the population of McKinley and Cibola Counties did not plummet dramatically but, instead, the population of McKinley County continued to grow while the population of Cibola County initially saw a decline of 4,700 or about one-sixth of the total population. Cibola's population then stabilized but did not begin rising significantly again until 1991. The combined population of these two counties hardly changed at all between 1982 and 1989, after which the population grew by about 20 percent through 2001. The population of the two-county study area then stabilized again through 2012. See Figure 16 below.

Figure 16.



The growth in the population of McKinley County does not appear to have been impacted by either the boom or bust of the uranium industry. The ongoing population growth despite the collapse of the uranium mining industry in McKinley County may have been due to the fact that many of the new workers associated with the uranium boom commuted into McKinley County but lived elsewhere. As a result, the impact of the collapse of the uranium industry was significantly shifted to surrounding counties. One of those counties, Cibola, experienced a decline followed by a slow growth in its population after the uranium bust in the early 1980s. Overall, the two-county study area experienced a pause in population growth after the uranium bust followed by modest

population growth. Given the size of the disruption associated with the uranium boom and bust, this combination of population stability and growth is impressive. See Figure 16.

#### *D. Changes in the Sources of Income*

Clearly there had to be other sources of employment and income to maintain the population after the loss of such a large number of mining jobs and the associated payroll. Despite the collapse of the uranium industry, real growth occurred in the payroll in retail and wholesale trade, finance, professional and business services, and government.<sup>77</sup> The continuing expansion of income flows not related to current employment, including investment income (dividends, interest, and rent) and income from government-supported retirement programs (Social Security, Medicare, and Veteran), also supported the ongoing economic expansion. Importantly the “trade and services” sectors showed no sign of reflecting the rapid expansion and then contraction of the mining sectors. Local “multiplier” or “ripple” effects are not visible. “Services” include the payroll in health care, business management and computer services firms, professions such as law, accounting, and architecture as well as repair services such as auto mechanics, electricians, and plumbers. Trade includes retail stores and the wholesale warehouses that supply them. See Figure 17 below.

Other sectors of the economy, such as construction, public utilities, and transportation, were somewhat affected by the expansion of mining activities and rose and fell modestly with mining, but, in general, remained stable or expanded after the decline in uranium mining. Some sectors, such as agriculture and manufacturing, went through their own cycles.

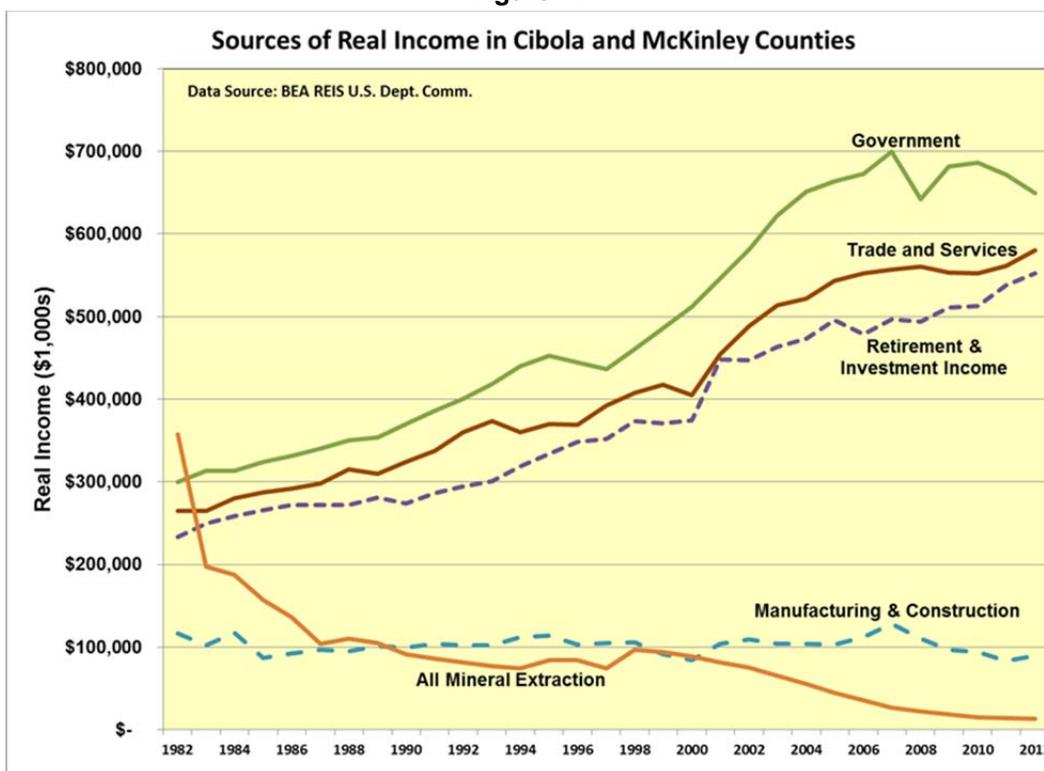
#### *E. Changes in Average Real Income*

In general the economies of McKinley and Cibola Counties made modest adjustments to the decline in uranium mining and then returned to a path of expansion. Mining was neither the primary source of local economic vitality nor a hindrance to continued economic expansion. More important, these counties showed considerable success in diversifying their economies in a way that supported ongoing economic vitality.

---

<sup>77</sup> The “government” income figures in Figure 17 do not include Social Security or Medicare or other government pension programs. Those are included in the “retirement and investment” category. In addition, government-funded mine remediation contract work is not included in the government category. Finally, Navajo Nation government expenditures are treated as private activities in the federal accounts and are not included in the government category either. “Government” income is exclusively the payroll associated with state, local, and federal government workers.

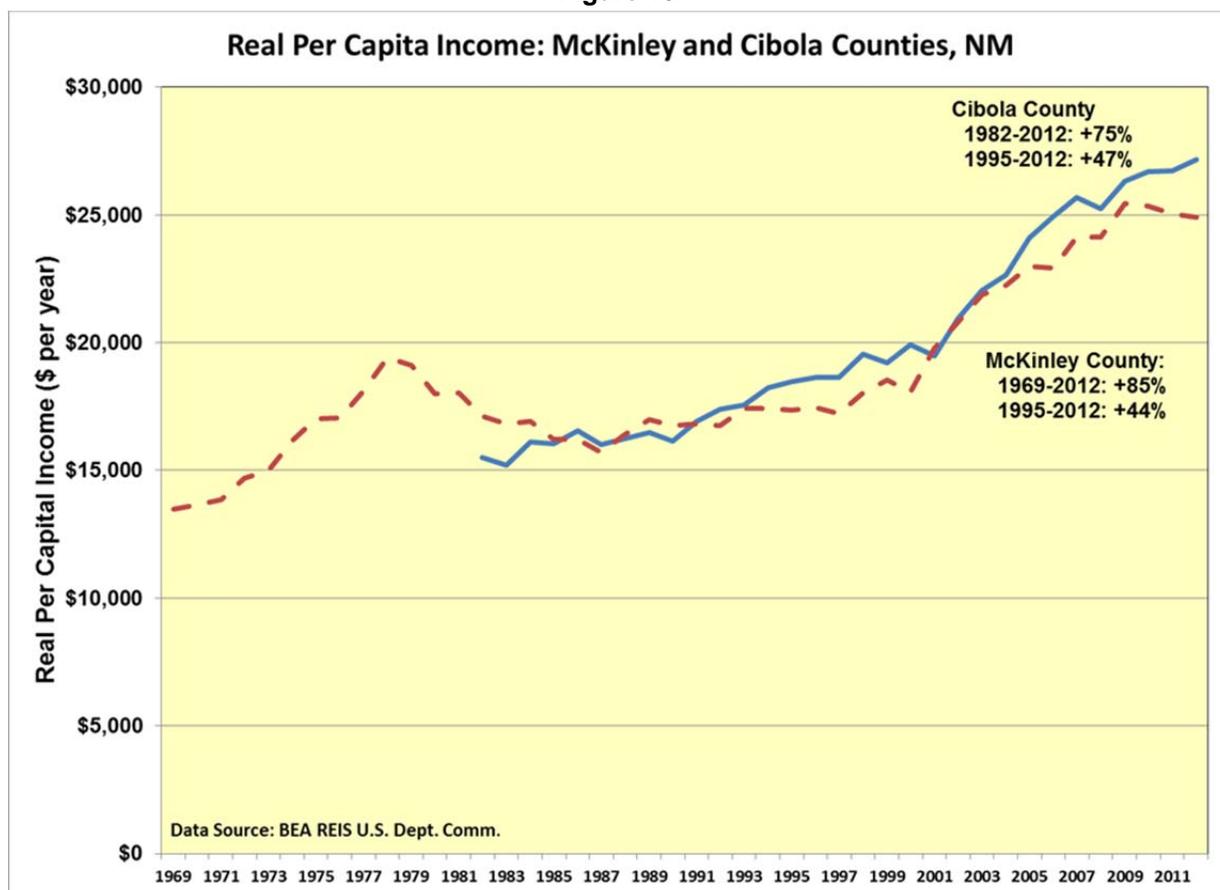
Figure 17.



For example, real per capita income, a common measure of local economic well-being, improved significantly over the last several decades in both McKinley and Cibola Counties. Per capita income grew by 85 percent in McKinley County between 1969 and 2012 after adjusting for inflation, and in Cibola County it grew by 75 percent in the shorter period after the uranium industry bust for which we have separate data, 1982-2012. For the more recent period, 1995-2012, Cibola saw real per capita income grow by 47 percent.

However, the gain and then loss of the high-paying mining jobs is apparent in the trends in real per capita income for McKinley County. Real per capita income rose steeply as the uranium boom of the 1970s developed and then declined as those mining jobs were lost in the 1980s. Average real incomes did not begin to bounce back in McKinley County until 1988. In Cibola County, on the other hand, real per capita incomes were again rising by 1983. Over the last 17 years, average real incomes have improved by 40 to 50 percent in both of the counties. See Figure 18 below.

Figure 18.



Real per capita incomes in these counties, nevertheless, remain significantly below those of the state as a whole. There are two primary explanations for this. First, these are largely rural areas with relatively small cities. Gallup, far to the west, with a population of about 22,000, is the largest city in the two-county area. Grants, the seat of Cibola County, has about 9,000 residents. Rural areas across the nation tend to have significantly lower incomes partly because they also tend to have lower costs of living compared with larger metropolitan areas.<sup>78</sup> The average per capita income in New Mexico as a whole is dominated by four metropolitan areas where about two-thirds of the population resides. So it is not surprising that non-metropolitan counties in New Mexico have lower per capita incomes than New Mexico as a whole. Similarly, the per capita income of the United States is dominated by the 85 percent of the population that lives in metropolitan areas.<sup>79</sup> So when we compare McKinley and Cibola Counties with

<sup>78</sup> *Post-Cowboy Economics: Pay and Prosperity in the New American West*, T.M. Power and R.N. Barrett, Island Press: Washington D.C., 2001, Chapter 5.

<sup>79</sup> U.S. Department of Agriculture, Economic Research Service, <http://www.ers.usda.gov/topics/rural-economy-population/population-migration.aspx>.

the United States as a whole, we are effectively comparing rural counties with the largest urban areas in the nation.

Second, McKinley County is closely associated with the Navajo Reservation. About three-quarters of the county population is Native American. Outside of Gallup, over 90 percent of the population is Native American. Cibola County also has a sizable Native American population, 41 percent of the total population. There are fewer than 10 of America's 3,100 counties where Native Americans make up a larger percentage of the population than in McKinley County and less than 20 counties with Native American populations that have a larger percentage of total population than in Cibola County.<sup>80</sup> The low per capita incomes in those counties also reflect the lower average incomes of Native Americans and their relatively high poverty and unemployment rates compared to either the nation or New Mexico. The poverty rate in McKinley County between 2008 and 2012 was 34 percent and in Cibola County, 29 percent, compared with 19.5 percent for New Mexico as a whole.

#### ***F. Changes in Unemployment***

Unemployment rates across the state and in Cibola and McKinley Counties declined during the 1990s as the growth of jobs continued. By 2007, unemployment rates were down in the 4 percent range, considered by most economists to be about as low as they can go given the natural turnover in employment as a result in both worker decisions to change employment and business decisions to deploy new technologies or to open and close facilities.<sup>81</sup> See Figure 19 below.

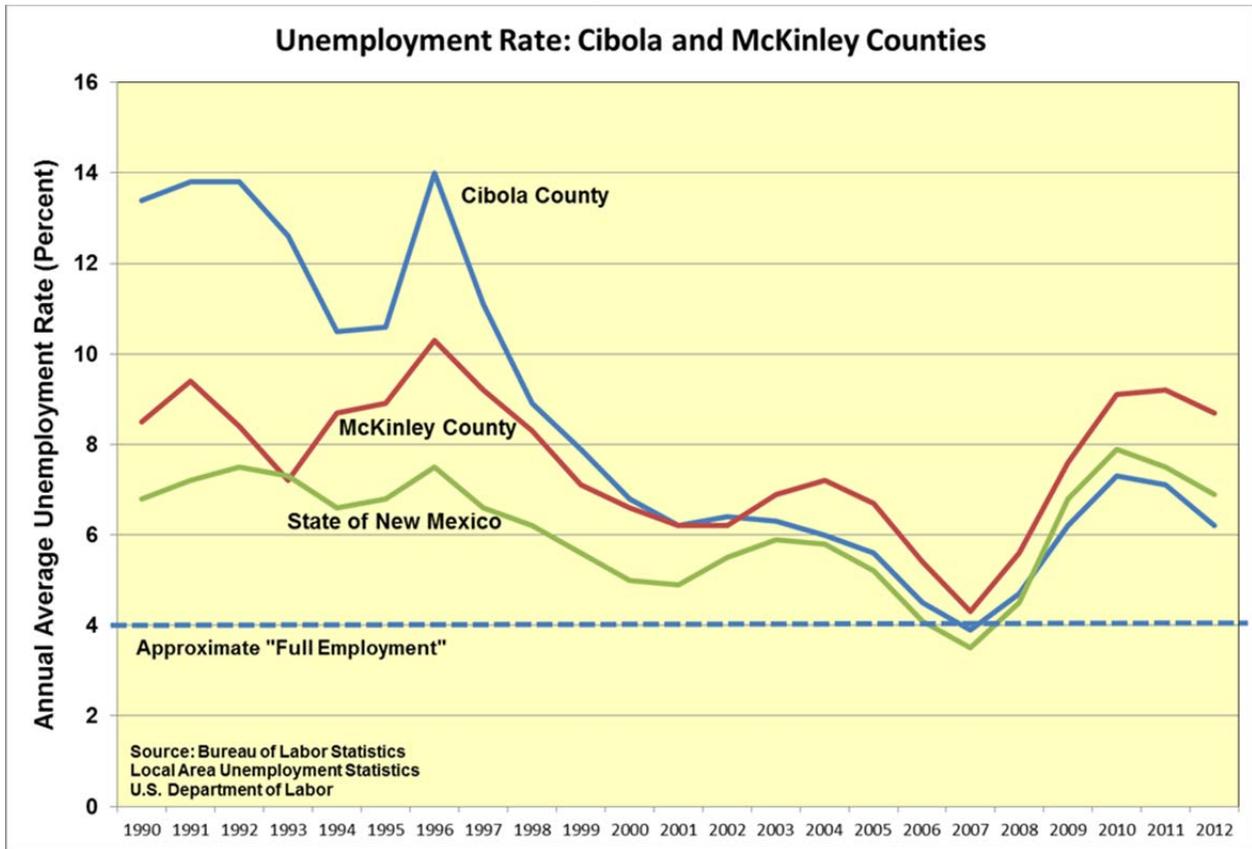
As shown in Figure 19, the official unemployment rates in Cibola and McKinley Counties were well above the state-wide level until the expansion in the national economy in the 1990s brought down the official unemployment rate in both counties and within the state as a whole, towards full employment. The onset of the Great Recession after 2007 and its impacts led unemployment rates to rise significantly in both counties and the state as a whole. Interestingly, the official unemployment rate in Cibola County eventually fell *below* that of the state-wide rate in 2008 but after that date the unemployment rate in both New Mexico and Cibola County both rose significantly.

---

<sup>80</sup> <http://www.indexmundi.com/facts/united-states/quick-facts/all-counties/american-indian-and-alaskan-native-population-percentage> .

<sup>81</sup> Unemployment rates on Indian reservation are regularly reported to be high in the double digits. The *official* unemployment rate only measures what percentage of those holding jobs or actively seeking jobs currently do not have jobs. It does not include those who are so discouraged about finding and holding a job that they have dropped out of the labor force and are no longer seeking a job. It also does not measure under-employment as when someone is working part-time but wishes to be working full-time or is working at a job far below their skill level. Both Cibola and McKinley Counties have been labeled "low employment" counties because the percentage of working-age people (age 21-64) actually working is less than 65 percent. This may represent a large number of discouraged workers not included in the official unemployment figures.

Figure 19.



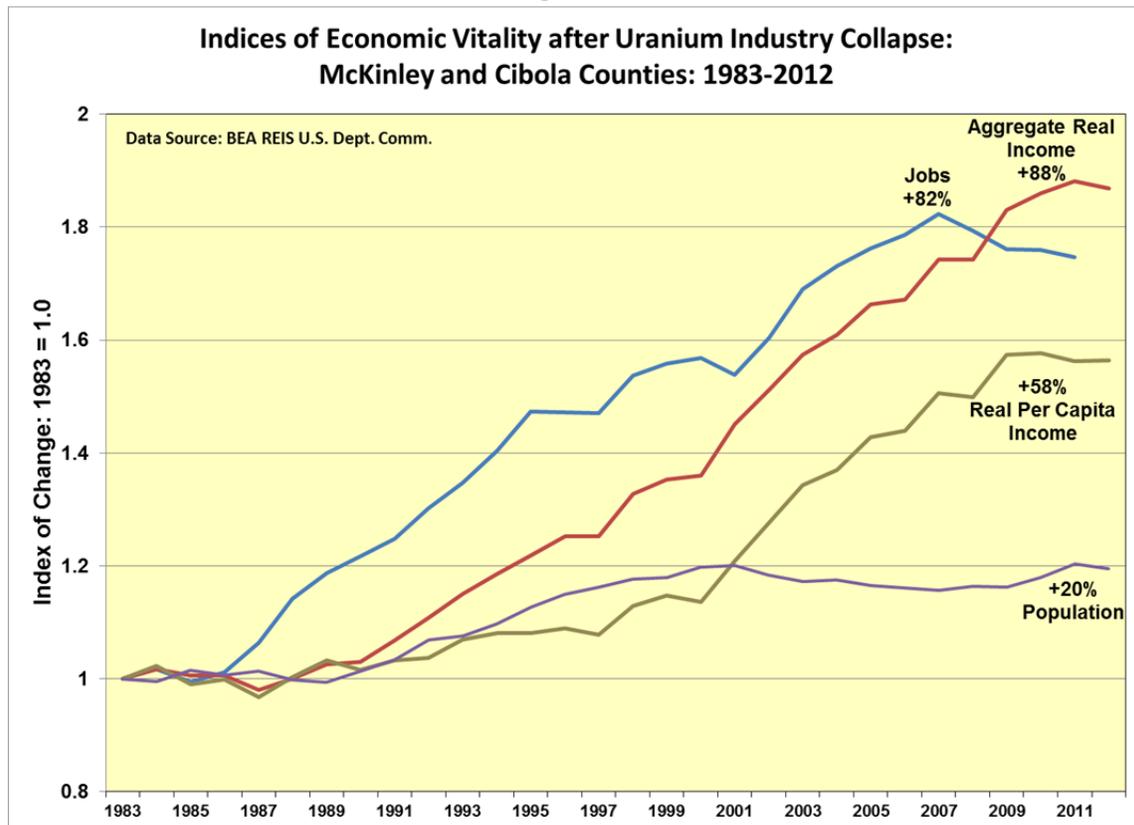
### 3. Conclusions on Cibola and McKinley County Areas' Adjustment after the Uranium Mining Boom and Bust

About 7,000 uranium-related jobs were lost during the 1980s as uranium mining and milling were abandoned in New Mexico. Total mining jobs in New Mexico declined by about 10,700 when the copper mining and smelting employment losses in the 1980s are also included. But the New Mexico economy was large and diverse enough to digest these jobs losses as it added over 480,000 jobs between 1979 when the mining collapse began and 2012. That job growth was almost 50 times the number of metal mining jobs lost as a result of the mining collapse. As a result, the overall New Mexico economy expanded and diversified significantly so that by the year 2000, when data on metal mining jobs ceased to be reported separately from mining overall, metal mining was the source of only about one out of every 600 jobs in New Mexico. During the nearly three-decades between the beginning of the uranium bust to the beginning of the Great Recession, the unemployment rate also dropped to historically very low levels in New Mexico.

Because uranium mining was concentrated in two rural counties, Cibola and McKinley Counties, they experienced the impacts of both the uranium boom and the collapse that followed. But even at this local level, the non-mining sectors showed considerable resilience, allowing the local economies to digest the loss of a major local industry and return to a growth path within a few years.

It is important to understand that despite the half-billion-dollar uranium boom and bust in real earnings in mining in the Cibola-McKinley study area with a corresponding gain and then loss of about 6,000 mining jobs, non-mining income and earnings in the study area were hardly affected at all. See Figures 14 and 15 above. The mining sectors were effectively isolated from the rest of the local economy during both the boom and the bust. After the uranium bust, government, services, and trade sectors continued to expand as did income from retirement and investments. See Figure 17 above. After digesting the loss of the uranium mining jobs, employment, aggregate real personal income, real per capita income in the Cibola-McKinley study area rose significantly and unemployment rates declined. Population in Cibola County declined and then grew slowly while population in McKinley County grew modestly until 2000. However, average incomes remain below state levels due to the rural characteristics of the area and the high poverty rates and low incomes associated with the significant Native American populations in McKinley and Cibola Counties.

**Figure 20.**



These indicators of ongoing economic vitality and well-being in the Cibola-McKinley study area, despite the loss of the uranium industry, are summarized in Figure 20 above.

At least part of the success of the local economies in the Cibola-McKinley area has been tied to the very conscious local effort to redefine the communities and area as something more than just a mining-centered economy in decline. The Grants-Milan area of Cibola County made significant post-mining public investments in new local infrastructure such as the Riverwalk Park along the San Jose River, the Mining Museum, a Cibola Arts Council facility, a new high school, and improved roads. Local economic activities that brought new income into the area included recreation, tourism, tribal gaming, and new regional correctional facilities. The Grants area has worked hard to prove it was not a just a mining town on the path to becoming a “ghost town” as a result of the decline in uranium mining. The Mount Taylor Winter Quadrathlon, the development of mountain biking trails, and the Coyote Del Malpais golf course aim to establish an outdoor recreation identity for the Grants area

Gallup, the seat of McKinley County, has been pursuing similar objectives. “Adventure Gallup” has been working since 1999 when it emerged from the Comprehensive Economic Development Strategy planning process. The idea was to build new economic development based on local assets in the Gallup area and treating “everything good that Gallup has to offer” as part of the local economic base. This had the effect of acknowledging the importance of adventure tourism to the area around Gallup and supporting its expansion. Examples include the High Desert Trail System developed on private land to which McKinley County has acquired an easement and a number of annual biking and running events. Developing adventure tourism was seen as a way to create greater economic opportunity while also supporting education, recreation, culture and health for local residents and enhancing the quality of life.<sup>82</sup>

---

<sup>82</sup> “10-year Impact of Adventure Tourism: McKinley County, NM: Economic Impact Report,” Northwest New Mexico Council of Governments, September 2013.  
[http://www.nwnmcog.com/uploads/2/7/9/8/2798127/agb\\_adventure\\_tourism\\_10-year\\_impact\\_study.pdf](http://www.nwnmcog.com/uploads/2/7/9/8/2798127/agb_adventure_tourism_10-year_impact_study.pdf)

## Appendix: The Errors in the USFS Cibola National Forest Estimates of the Local Impacts of the Proposed Roca Honda Uranium Mine

### A. Stating Economic Impacts as a Cumulative Sum over the Life of a Mine

The U.S. Forest Service economic impact IMPLAN modeling results that were reported in the DEIS for the proposed Roca Honda Mine and in the information the Arrowhead Center developed for Roca Honda Resources are presented in a way that seriously exaggerates the likely economic impacts. Because of some critically incorrect labels used to characterize the impacts and an unconventional method of portraying the benefits of the mine over the life of the mine, the estimated economic impacts are made to appear much larger than they actually are. It is critical to correct those exaggerations and present the economic impact results in *annual* terms rather than as the sum of annual impacts over the life of the mine.

A casual review of the DEIS economic impacts shown in Table 1 above reveals some of the serious errors. For instance, the payroll associated with the 253 workers directly employed by the proposed mine is reported as almost \$161 million but the payroll associated with the 791 induced jobs, three times the number of the direct jobs, is only \$6.6 million, only 4 percent of what the much smaller number of direct employees are paid. The same is true of the estimates of the total value of economic activity associated with these various employment impacts.

The source of this inconsistency in the DEIS reported economic impacts summarized in Table 1 above is that the only *annual* impact shown in DEIS Table 63 is the estimated direct jobs associated with the mine. All the other estimated economic impacts of the proposed mine are based on the sum of the impacts over the assumed 11-year life of the mine, even though they are sometimes labeled as annual impacts. This can be shown through some simple arithmetic calculations.

If one divides the salaries and wages associated with the direct employment by that direct employment, the implied annual wage is almost \$730,000. It is extremely unlikely that Roca Honda is planning to pay each of its mine workers almost three-quarters of a million dollars per year. If, instead, one divides the salaries and wages associated with the reported number of indirect jobs created, the implied annual wage is \$47,457 per job. The mine workers, apparently, will get paid over 15 times as much as the workers in mine supply businesses. That, too, is very unlikely, although the wage level for the mine supply workers is a much more believable annual wage.

In general, economic impacts are reported on an annual basis. This is important because the time dimension of the job or payroll or tax impact has to be specified or the numbers reported cannot be compared or evaluated. For instance, if a mine were projected to operate for 30 years with a workforce of 500 and the annual pay associated

with the mining jobs was \$60,000, reporting that 15,000 jobs would be created or that the average pay associated with each job was \$1.8 million would be grossly misleading. The economic impacts would vary widely depending on the expected life of the operation of the mine. The conventional standard for the reporting of such economic information is to report annual impacts and then, if it is important, also report on the number of years over which that annual economic impact was expected to last.<sup>83</sup>

Roca Honda Resources also reports its estimated mine economic impacts as a sum of annual impacts over the life of the mine, often without indicating that that is what is being done. For instance Roca Honda Resources presentation on the economic impacts of the proposed mine to the New Mexico Legislature, it presented the results of an economic impact analysis done for it by the Arrowhead Center of New Mexico State University. The employment, payroll, and government tax revenues were all sums over the life of the mine without that being specifically stated. Roca Honda, however, *also* did state the jobs impacts in terms of average annual jobs.<sup>84</sup>

In 2008 the Arrowhead Center released a report on “The Economic Impact of Proposed Uranium Mining and Milling Operations in the State of New Mexico” that had been commissioned by the Uranium Producers of New Mexico.<sup>85</sup> The “proposed uranium mining and milling operations” included the construction of 15 mine and three mills over the 2008-2012 period. Those uranium facilities were then assumed to operate uninterrupted for 30 years. Those new uranium facilities would have been located primarily in McKinley and Cibola Counties.<sup>86</sup>

The Arrowhead Center’s estimated economic impacts of this projected major expansion of uranium activities were huge. The direct employment in the uranium mines and mills was projected to be almost 98,000 workers earning wages and salaries totaling over \$8 billion. With ripple or multiplier impacts included, the total employment impact was almost a quarter of a million workers with a payroll impact of over \$14 billion.<sup>87</sup>

But, in 2008 the total jobs in McKinley and Cibola Counties in all lines of work totaled only about 41,000. Those jobs paid wages and salaries totaling about \$1.4 billion.<sup>88</sup> An

---

<sup>83</sup> There are situations where jobs may last less than a year or for only a few years (e.g. construction jobs). In that setting “man-years” or “worker-years” of labor effort may be reported. Similarly, some jobs are part-time and employment impacts may be exaggerated if full-time and part-time jobs are added together. In those setting, “full-time-equivalent jobs” may be calculated. What is important is that specific language is used to distinguish these aggregations of jobs across time periods from “jobs,” “employment,” “income,” “payroll,” or “tax payments,” which are always reported on an annual basis.

<sup>84</sup> Op. Cit. Roca Honda Resources’ presentation to a meeting of the Economic and Rural Development Committee, July 8-9, 2013, Farmington, NM, slide 3. A footnote on that slide said that New Mexico State University Arrowhead Center developed the impact estimates in November 2012.

<sup>85</sup> James Peach and Anthony V. Popp, New Mexico State University, August 1, 2008.

<sup>86</sup> Ibid. p. 80. This was the “base case.” A high and low impact scenario were also analyzed.

<sup>87</sup> Ibid. p. 8.

<sup>88</sup> BEA REIS U.S. Department of Commerce. Earnings are stated in 2012 dollars.

increment of 98,000 new jobs in McKinley and Cibola Counties paying \$8 billion would represent a spectacular change in those two rural counties.

But even though the Arrowhead Center summarized the direct impacts of the “proposed” new uranium industry in those two counties in those terms, that is not what they meant. These very large employment and payroll impacts were the sum of the actual *annual* impacts over the assumed 30-year life of the “proposed” new uranium facilities. For the Roca Honda Mine, the job and payroll impacts were summed over the assumed 13-year life of the proposed mine.

To obtain the actual number of jobs being created and the actual annual payroll that would be paid if the Roca Honda Mine proceeded, one has to divide these Arrowhead Center or USFS DEIS estimated impacts by 11. The actual impacts the communities would experience would be about 9 percent of what the USFS DEIS Arrowhead Center summary tables suggested.

## **B. Over-Statement of Impact “Multipliers”**

There are also obvious problems with the size of the ripple or multiplier impacts reported in the Roca Honda DEIS and reproduced in Table 1 above. The employment multiplier implied by the estimated total number of jobs created (including the multiplier impacts) and the direct employment at the proposed mine is 4.68. It is extremely unlikely that the economies of the rural counties of Cibola and McKinley could support a job multiplier this size. A job multiplier of this size would imply that for every job directly created by the mine, close to 4 additional jobs would be created in Cibola and McKinley counties in support of the mine and the miners. Interestingly, the multipliers that the DEIS appears to apply to payroll and the value of economic output are much smaller, about 1.2. Apparently although lots of additional jobs are created, not much additional payroll is paid out and not much more is produced in the overall economy. This does not make sense.

The authors of the Roca Honda DEIS section on the economic impacts of the proposed mine seem to have been aware of the fact that the job multiplier should have been much smaller. In a comment box entitled “The Employment Multiplier” (p. 289), the DEIS gives an explanation and example of a hypothetical mine’s employment multiplier. The example used led to an employment multiplier of 1.3, not 4.7. A multiplier of 1.3 is also more consistent with the payroll and output multipliers of 1.2 in the DEIS. As discussed below, the employment multiplier implicit in Power Consulting’s IMPLAN modeling of the proposed Roca Honda mine is also 1.3.

Employment multipliers in the range of 4 or 5 occur only when a very large and sophisticated urban economy is included as part of the study area. For instance, if the study area included the entire national economy, the calculated ripple or jobs multiplier impacts *might* be this large.

It should be pointed out that the job multiplier impacts that Roca Honda Resources reported to the New Mexico Legislature were much smaller than what the DEIS estimated: 1.7 instead of the DEIS estimate of 4.7. That is, the DEIS job multiplier is almost 3 times as large as the job multiplier estimated for Roca Honda Resources by the Arrowhead Center at NMSU.<sup>89</sup>

Power Consulting used the same IMPLAN model used by the U.S. Forest Service in the DEIS to model the proposed mine. We adopted the same study area (McKinley and Cibola Counties) and assumed the direct mine employment would be the higher of the two job numbers provided in the DEIS. Our results are shown in Table 3 below.

**Table A.**

<b>Power Consulting IMPLAN Modeling of Proposed Roca Honda Mine McKinley and Cibola Counties Study Area Using DEIS Assumptions</b>			
<b>Type of Impact</b>	<b>Jobs</b>	<b>Labor Income</b>	<b>Sales Value of Output</b>
Direct	253	\$15,177,164	\$45,337,260
Indirect	11.9	\$597,507	\$3,434,672
Induced	76.9	\$2,168,828	\$7,973,287
Total	340.8	\$17,943,499	\$56,745,220

Note that our estimated job multiplier impacts, the ratio of total jobs to direct jobs, are much smaller. Every 10 direct mining jobs have ripple effects that lead to another 3.5 jobs in McKinley and Cibola Counties, not the 36.8 additional jobs that the DEIS projects. Also note that the labor income associated with direct jobs, is only a fraction of what the DEIS projected. The implied average wage in mining is \$60,000 not \$730,000 per year.

The anomalous economic impacts reported in the DEIS are due to the fact that most of the economic impacts reported are not stated in *annual* terms but as a sum of impacts over the eleven-year life of the mine.<sup>90</sup> This effectively multiplies all of the estimated impacts by a factor of 11. In fact, the only portion of the DEIS Table 63 that is actually an annual impact is the number of direct mining jobs.

---

Ibid. The direct mining jobs were 224 while the total jobs were 375 per year.

<sup>90</sup> The "Technical Report on the Roca Honda Project" prepared by RPA for Roca Honda Resources (August 2012) states the life of the mine as 9 years (p. 22-5). The Roca Honda DEIS says that mining operations will take place for 18.5 years (p. 279), but this includes mine development, operations, and reclamation. In the Roca Honda DEIS Table 55 on page 288, the operation period for the mine is given as 11 years. Roca Honda Resources in its presentation to the New Mexico Legislature indicates that the operational period of the mine would be 11 years. (460 jobs over the operational period or 42 jobs per year.) "Roca Honda Resources Mine Project for ERDC, July 8-9, 2013, p. 3. We have used 11 years as the life of the mine.

If we take the DEIS table of economic impact results reproduced in Table 1 above and divide all of the impacts except for the direct mine employment by the 11-year life of the mine, the results are shown in Table 4 below. The total effects in Table 4 are the sum of the adjusted direct, indirect, and induced effects.

If these results in Table 4 below are compared to the Power Consulting IMPLAN re-modeling results shown in Table 3 above, the results are quite similar. This comparison is found Table 5 below.

**Table B.**

<b>DEIS Economic Impact of Roca Honda Mine Operation-Adjusted</b>			
<b>Type of Impact</b>	<b>Employment</b>	<b>Wages and Salaries</b>	<b>Sales Value of Mine Output</b>
Direct Effect	253	\$14,596,874	\$45,337,260
Indirect Effect	12.7	\$604,001	\$2,669,692
Induced Effect	71.9	\$2,063,715	\$7,178,455
<b>Total Effect</b>	<b>337.6</b>	<b>\$17,264,590</b>	<b>\$55,185,407</b>
Source: Roca Honda DEIS, Table 63, p.294. All values but Direct			
Employment divided by the 11-year live of the mine.			
Total is the sum of direct, indirect, and induced effects.			

What the comparison in Table 5 below shows is that this adjustment of the DEIS table of economic impact results in almost identical results to those that resulted from the Power Consulting IMPLAN modeling of the Roca Honda Mine on McKinley and Cibola Counties using the DEIS assumptions.

**Table C.**

<b>Comparison of Adjusted DEIS Modeling with Power Consulting Remodeling Roca Honda Proposed Mine. McKinley and Cibola Counties Study Area.</b>			
<b>DEIS-Adjusted as a Percent of Power Consulting Remodeling</b>			
<b>Type of Impact</b>	<b>Employment</b>	<b>Wages and Salaries</b>	<b>Sales Value of Mine Output</b>
Direct Effect	100%	96%	100%
Indirect Effect	107%	101%	78%
Induced Effect	94%	95%	90%
<b>Total Effect</b>	<b>99%</b>	<b>96%</b>	<b>97%</b>

That is, the very large estimated economic impacts of the Roca Honda Mine reported in the Roca Honda DEIS were the result of summing the annual impacts over the life of the mine. The economic impacts reported in the DEIS are not the *annual* impacts that should have been reported. The impacts reported in the DEIS are exaggerated by a factor of 11.

The point of this exercise is that the Roca Honda DEIS reported the economic impacts in an inconsistent manner, mixing annual impacts with impacts over the life of the mine. The result was implausibly large implied annual wages and implausible employment multipliers. This could have been avoided by either replacing the annual direct jobs in Table 63 of the DEIS with a “life of mine” direct jobs (i.e. multiplying by the number of years that the mine is expected to operate) or all of this table, aside from the direct jobs, should be divided by eleven to show annual impacts as in Table 4 above.

Conventionally, economic impacts are presented in annual terms. When a worker first gets a new salaried job, her employer generally would not tell her the amount of money that she would receive over an eleven year period or her lifetime if the job lasted that long. Setting professional sporting contracts aside, general convention would use *annual* employment, *annual* salaries and wages, and *annual* economic activity or sales value. When we remodel the impact of the Roca Honda project on Cibola and McKinley Counties **on an annual basis**, the table of projected impacts looks very much different. (See Table 3 above).

The ripple or multiplier impacts for employment, payroll, and the value of mine output are appropriately smaller and similar: 1.35 for jobs, 1.2 for payroll, and 1.25 for value of output. The smaller ripple or multiplier effects is what would be expected given the rural nature of Cibola and McKinley counties, which would very likely have a hard time supporting much of the mining-related employment besides the direct jobs in the mine. In other words, it is very likely that much of the “ripple effect” on employment and mine output would leak out of these rural counties to the larger metropolitan areas like Albuquerque or to other trade centers in the nation.

This leakage of economic activity associated with the mine out of these rural counties should not come as a shock. A uranium mine requires large, capital intensive purchases of mining equipment that could not possibly be manufactured or purchased in Cibola or McKinley counties. Cibola and McKinley counties do not, for instance, have a manufacturing facility for “966 Front-end Loaders,” “D-6 Dozers,” “dump trucks,”<sup>91</sup> or any of the other specialized heavy equipment required for the proposed Roca Honda mine.<sup>92</sup> A large metropolitan area like Albuquerque that dwarfs the Cibola and McKinley county economies is much better suited to sell or even manufacture technical mining equipment. Albuquerque is the largest city in New Mexico; it is within 100 miles of the

---

<sup>91</sup> Op. cit. Technical Mining Plan, 2012, Table 18-2 Surface equipment fleet, p. 18-10.

<sup>92</sup> IMPLAN version 3 Study Area Data for McKinley and Cibola counties shows no employment in Heavy duty truck manufacturing (or any other type of metal equipment manufacturing aside from a small amount of employment in trailer manufacturing).

proposed Roca Honda mine; and it has a diversified economy approaching one million people.<sup>93</sup> Cibola and McKinley counties, in comparison, have a combined total population of about a tenth of the city of Albuquerque.<sup>94</sup>

Even if the value of the mine output is more than doubled, and the salary per direct worker is raised to \$75,000 per year rather than the \$60,000 the DEIS assumed, and the larger number of direct mine workers, 253, is used, the multiplier for direct to total jobs is still only 1.53.<sup>95</sup> This is only a small fraction of the 4.68 job multiplier implied by the DEIS Table 63. The total employment including ripple effects after making all of these upward adjustments would be 387 jobs. This highlights the potential economic impacts of a uranium mine of this size. Even if the total value of the output of the mine is more than doubled and the assumed annual pay per mine worker is increased 50 percent, the total employment for the region increases by only 50 workers.<sup>96</sup>

---

<sup>93</sup> ["Metropolitan and Micropolitan Statistical Areas Totals: Vintage 2011 - U.S Census Bureau"](#).

Census.gov. Retrieved 2013-06-27.

<sup>94</sup> IMPLAN version 3, model year 2011.

<sup>95</sup> Power Consulting IMPLAN analysis based on 253 directly employed miners, an annual pay of \$75,000, and direct annual output of \$105,945,088 based on the RPA "Technical Report on the Roca Honda Project, McKinley County, New Mexico, U.S.A." The Arrowhead Center analysis of the proposed mine for Roca Honda Resources estimated the average annual pay of the miners at \$75,000. Op. cit. Roca Honda Resources LLC Mine Project presentation to N.M. Legislature, 2013, p. 3.

<sup>96</sup> It should be pointed out that the dollar value of the output of the mine, i.e. the sales value, which the DEIS labels the level of "economic activity," is not a very relevant number when estimating local economic impacts. The dollar value of output has to cover the costs of the workforce both local and national, the supplies and services purchased even if purchased in national or international markets, the debt payments, dividend payments, and other forms of profit, etc. In that sense the value of output does not measure local impacts and double counts the wages and salaries and other value added. It is one of the largest numbers associated with the mine that can be stated, which makes it attractive for public relations purposes. But it is not a very relevant number in terms on actual local impacts.

Nonetheless, it appears that the DEIS IMPLAN modeling used the wrong sales value for the output of the proposed mine in the last column of the tables above. The value of the output of the mine listed in Table 63 of the DEIS is about \$500 million (see Table 1 above). If one carries the direct value of the uranium mined through, from the values given in the DEIS on p. 293, the direct output could be as large as \$1.7 billion. If the DEIS's direct output is to be believed, it implies that less than one third of the value of the estimated uranium reserves contribute toward the value of the direct output. If the 2012 Technical Mining Plan (Tables output associated with the mine that was used in the DEIS is still less than half of what was used to model the economic impacts in the DEIS. It is unclear as to what the source of the DEIS's estimate of the value of the mine's output was. The DEIS citation given for this economic information cites a personal communication (DEIS p. 487) in response to an information request to Roca Honda Resources from the Cibola National Forest about "socioeconomic questions." This leaves the source of this inconsistency in the projected economic impacts unclear.

## Bibliography

- Arrowhead Center. The Economic Impact of Proposed Uranium Mining and Milling Operations in the State of New Mexico. August 1, 2008.
- Cameco. <http://www.cameco.com/>
- Cornell, J. Secondary Supplies: Future Friend or Foe? World Nuclear Association. World Nuclear Association Symposium 7-9 September 2005. <http://www.world-nuclear.org/sym/2005/pdf/Cornell.pdf>
- Department of Energy. Annual Energy Outlook 2011. DOE/EIA-0383(2011). April 2011. <http://www.eia.gov/forecasts/archive/aeo11/pdf/0383%282011%29.pdf>
- Department of Energy. Annual Energy Outlook 2013. DOE/EIA-0383(2013), April 2013.
- Energy Fuels. Energy Fuels announces quarterly results for the three and twelve months ended September 30, 2013. [http://www.energyfuels.com/mobile/news/index.php?&content\\_id=277](http://www.energyfuels.com/mobile/news/index.php?&content_id=277)
- Energy Fuels. Energy Fuels Corporate Update. October 31, 2013. [http://www.energyfuels.com/mobile/news/index.php?&content\\_id=274](http://www.energyfuels.com/mobile/news/index.php?&content_id=274)
- Hall, S. Critical Analysis of World Uranium Resources. USGS. March 22, 2013. <http://pubs.usgs.gov/sir/2012/5239/>
- Kovash, J. Plan to Idle White Mesa Mill Sends Shockwaves Through Uranium Country. Utah Public Radio. November 25, 2013. <http://upr.org/post/plan-idle-white-mesa-mill-sends-shockwaves-through-uranium-country>
- Lum, R. Moody's: Building new nuclear a 'bet the farm' endeavor for most companies. SNL Energy. July 10, 2009.
- Mack, G. Why Uranium Prices Will Spike in 2013: Raymond James. The Energy Report. August 23, 2012. <http://www.theenergyreport.com/pub/na/why-uranium-prices-will-spike-in-2013-raymond-james>
- McLemore, V. Uranium Resources in New Mexico. New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology. SME preprint, 2007 annual meeting.

M.I.G. IMPLAN V. 3. <http://implan.com/>

New Mexico Energy, Minerals, and Natural Resources Department. Annual Reports 2010-2012.

New Mexico Energy, Minerals, and Natural Resources Department. Mining and Minerals Division.

<http://www.emnrd.state.nm.us/Mmd/MRRS/documents/Uranium.pdf>

Northwest New Mexico Council of Governments. 10-year Impact of Adventure Tourism: McKinley County, NM: Economic Impact Report. September 2013.

[http://www.nwnmcog.com/uploads/2/7/9/8/2798127/agb\\_adventure\\_tourism\\_10-year\\_impact\\_study.pdf](http://www.nwnmcog.com/uploads/2/7/9/8/2798127/agb_adventure_tourism_10-year_impact_study.pdf)

Nuclear Energy Agency-International Atomic Energy Administration. 2009 Red Book. 2010.

Peach, J. Letter from James Peach to The Honorable John Arthur Smith, New Mexico State Senator. Arrowhead Institute, New Mexico State University. October 8, 2008.

Peach, J., Popp, A. The Economic Impact of Proposed Uranium Mining and Milling Operations in the State of New Mexico. Commissioned by the Uranium Producers of New Mexico. New Mexico State University. August 1, 2008.

Power, Thomas Michael. 2008. "An Economic Evaluation of a Renewed Uranium Mining Boom in New Mexico," a report prepared for the New Mexico Environmental Law Center.

Power, Thomas Michael and Richard N. Barrett. 2001. ***Post-Cowboy Economics: Pay and Prosperity in the New American West***, Island Press: Washington D.C, Chapter 5.

Rico, G. Mining industry brightens with soaring price of copper. Arizona Daily Star. July 12, 2008. [http://azstarnet.com/business/mining-industry-brightening-with-soaring-price-of-copper/article\\_6da00297-641e-5537-b5c2-778e61f13132.html](http://azstarnet.com/business/mining-industry-brightening-with-soaring-price-of-copper/article_6da00297-641e-5537-b5c2-778e61f13132.html)

Roca Honda Resources. Roca Honda Resources LLC Mine Project Second Meeting of the Economic and Rural Development Committee. July 8-9, 2013 Farmington, NM.

Roscoe Postle (USA) Ltd. Technical Report on the Roca Honda Project, McKinley County, New Mexico, U.S.A. Prepared for Roca Honda Resources, LLC. Report for NI 43-101 Including updated mineral resource estimate and preliminary economic assessment. August 6, 2012.

TMX. Ten Year Chart. Energy Fuels Inc. (EFR)

[http://web.tmxmoney.com/charting.php?gm\\_page=21991&gm\\_symbol=EFR](http://web.tmxmoney.com/charting.php?gm_page=21991&gm_symbol=EFR)

USDA. Draft Environmental Impacts Statement for Roca Honda Mine. MB-R3-03-25. February 2013.

U.S. Department of Commerce. Bureau of Economic Analysis.

<http://www.bea.gov/regional/>

U.S. Department of Commerce. United States Census Bureau. Population Estimates. Metropolitan and Micropolitan Statistical Areas.

<http://www.census.gov/popest/data/metro/totals/2011/index.html>

U.S. Department of Labor. Local Area Unemployment Statistics.

<http://www.bls.gov/lau/>

UxC. UxC Historical Ux Price Charts. <http://www.uxc.com/>

Wilson, L. Riding the Resource Rollercoaster: a comparison of Socioeconomic Well-Being in Two Midwestern Metal Mining Communities. University of Wisconsin-Madison. December 2001. Also *Rural Sociology* 60(2):261-281, 2004.