An Economic Evaluation of a Renewed Uranium Mining Boom in New Mexico

a report prepared for the
New Mexico Environmental Law Center

BY

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About the Author

Thomas Michael Power is a Research Professor of Economics at the University of Montana. He retired from teaching and administration in 2007. He served as Chairman of the Economics Department from 1977 to 2007 and has served on the faculty there since 1968. His fields of specialization are resource economics and regional economics.

Professor Power received his undergraduate degree, cum laude and Phi Beta Kappa, in Physics from Lehigh University and his MA and PhD in Economics from Princeton which he attended on a Woodrow Wilson national fellowship. He has taught at Lehigh and Princeton, as well as the University of Montana.

Professor Power is the author or editor of six books including ***Lost Landscapes and Failed Economies: The Search for a Value of Place*** (Island Press, 1996), ***Post-Cowboy Economics: Pay and Prosperity in the New American West*** (with R.N. Barrett, Island Press, 2001), and ***Accounting for Mother Nature: Changing Demands for Her Bounty*** (with T.L. Anderson and L.E. Huggins, eds. Stanford University Press, 2007). He is also the author of over a hundred book chapters, articles, monographs, and reports. In addition, he is a regular commentator on Montana Public Radio and in the regional and national press.

Executive Summary

As a result of a substantial increase in uranium prices between 2004 and 2008, uranium mining companies have shown increasing interest in New Mexico's uranium reserves. After reaching peak levels of production in 1980, New Mexico uranium production plunged dramatically, reaching near-zero levels by 1990. This uranium boom and bust cycle had disruptive impacts in the area between Gallup and Laguna – the Grants mineral belt - where most of New Mexico's uranium mining and processing historically took place. Now uranium mining companies and other business interests are promoting renewed uranium mining as a potential source of $30 billion and almost 250,000 jobs for New Mexico and the Grants area.

This report carefully explores this "economic bonanza" view of renewed uranium mining by first evaluating the calculation that generates the $30 billion and 250,000 jobs figures. Then, to get some perspective on what a renewed uranium mining industry might entail, it looks back at New Mexico's economic experience with uranium mining over the last half-century. In order to understand whether New Mexico and the Grants area really need the economic stimulus that renewed uranium mining would allegedly provide, the report reviews the adjustments that have taken place since the uranium mining bust of the 1980s. With that as background, this report then estimates the upper end of the potential impact of a new uranium mining boom on employment, payroll, and state and local government revenues. The report ends with a discussion of the implications uranium mining has for the new "amenity-supported" economy that has been developing in New Mexico for several decades.

Based on the data and analysis contained in this report, I reach the following conclusions:

1. The $30 billion that industry claims would come to the state in a new round of uranium mining is a gross exaggeration built around indefensible economic assumptions. It assumes that uranium prices return to the $90 to $100 per pound range and stay there indefinitely into the future. It assumes that almost all of New Mexico's uranium reserves would be mined. It assumes that all of the value of the uranium extracted and processed accrues to New Mexico workers and citizens. Finally the $30 billion is based on adding up assumed benefits over a 30 year period, rather than focusing on the *annual* benefits. If more defensible assumptions are made, the upper end of the potential annual direct benefit to New Mexico workers will be only about two-tenths of one percent of that $30 billion claimed. See Sections I and V.

2. New Mexico knows from experience with copper and uranium that metal mining is economically unstable. The state has been through many copper mining booms and busts and a major uranium mining boom and bust cycle. These cycles are a natural feature of global mineral markets and will continue into the future. That means that a renewed uranium boom will also go bust, once again disrupting the economies of towns and regions in the state. Economic instability is one of the public costs associated with uranium mining that has to be balanced against the benefits. See Section II.

3. Since the uranium mining industry went bust in the early 1980s, the state and local economies have diversified, employment has been growing, average real income has been rising, and unemployment rates have returned to relatively low levels. Despite the loss of 10,000 metal mining jobs in New Mexico between 1979 and 2006, the state was able to add 50 new jobs for every metal mining job lost, a total of almost 500,000 new jobs. Real per capita income increased by 40 percent. The unemployment rate has been cut in half from 6.2 percent at the time of peak metal mining employment in 1978 to 3.3 percent in the first quarter of 2008. This is about as close to "full employment" as the economy can get. See Section III.

4. The economies of the Grants area (Cibola and McKinley Counties) have also survived the near disappearance of the uranium industry by successfully diversifying. These small, relatively rural, economies suffered through a half-billion dollar boom and bust in terms of mining payroll and lost 6,400 uranium jobs during the 1980s. But non-mining income and earnings were hardly affected. The mining sectors were effectively isolated from the rest of the economy during both the boom and bust. After the uranium bust, payroll for jobs in the government, services, and trade sectors continued to expand, as did income from retirement and investments. After digesting the loss of the uranium mining jobs, employment, aggregate real personal income and real per capita incomes in McKinley and Cibola Counties rose significantly, and by late 2007 unemployment rates had declined to near full employment levels, 3.5 to 4 percent. In the process, between 1983 and 2005, 17,000 new jobs were created, a 74 percent increase. See Section III.

5. Important environmental and social costs must be considered when evaluating the commercial economic benefits of renewed uranium mining. Uranium mining has most of the same near-permanent environmental costs that metal mining in general has and, because of its radioactive character, uranium poses some additional public health concerns. Substantial natural resources, such as groundwater, have been irreparably contaminated by uranium mining and therefore cannot be considered as a resource to support future economic growth in the area.

   In addition, New Mexico and local communities will need to consider how mine and mill waste will be addressed. At 0.1% average ore grade, the industry will only extract 2 pounds of uranium for each ton of ore mined at conventional mines. At 2 pounds per ton, 157.35 million tons of tailings would be created in order to produce 315 million pounds of uranium. New Mexico already has about 100 million tons of waste at its existing sites. See Section IV.

6. To extract almost all of New Mexico's uranium reserves, over 300 million pounds of uranium, the Uranium Producers of New Mexico have estimated that 15 new mines and 3 new mills will be required. This level of uranium development is highly unlikely for all of the following reasons:

a. It would require uranium prices to remain high (above $90 per pound) indefinitely into the future. Uranium markets have never behaved in this manner.

b. New Mexico, with only 2 percent of the world's uranium reserves will have to compete successfully with the rest of the world's uranium producers many of which have higher grade and lower cost reserves.

c. The Navajo Nation has banned uranium mining and milling in Navajo Indian Country, blocking the development of a substantial part of New Mexico's uranium reserves.

d. Most of the suggested new mines and mills have not yet begun the lengthy permitting process required before production could begin. In addition, new conventional mines probably would not be viable without the construction of a new mill. For those reasons substantial increases in uranium production cannot take place for many years into the future. A boom is not imminent.

e. The financial and credit crisis that developed in 2008 has already blocked some proposed uranium developments in New Mexico. Other suggested developments will also face financial constraints especially given the uncertainty about uranium prices.

f. The current low cost method of extracting uranium, *In Situ* Leaching, can only be applied to part of New Mexico's ore bodies.

7. ***Assuming*** that the uranium mining industry could recover almost all of New Mexico's economically feasible uranium reserves over the next 30 years (a highly unlikely scenario; see 7., below) the following are the economic impacts at the upper end of what is actually likely.

a. About 1,575 uranium mining and processing jobs could be created. In 2008 this would represent about one-seventh of one percent of total New Mexico employment. Since 2000 the New Mexico economy has created this number of jobs every 4 weeks

b. In Cibola and McKinley Counties where most of the mining would take place, these jobs would represent an increase in employment of about 4 percent. However, both counties are, according to the official unemployment figures, currently at close to full employment with less than 1,100 workers unemployed, and most of the unemployed are not miners. Most of the new mining jobs would therefore have to be filled by workers commuting in from other areas or new in-migrants, not existing residents.

c. These new jobs, incomes, and economic activity would have ripple or multiplier impacts that would generate additional jobs. This could increase the impact on personal income by 75 percent and the job impacts by 150 percent. Even then, those impacts would be very modest. Also, many of

those “multiplier” jobs would be located in the larger trade centers including Albuquerque where both businesses and workers make their purchases.

d. Tax revenues to the state government would total about $36 million per year in the state’s annual general fund budget of $6 billion and total budget of $13 billion. The potential state tax revenues from uranium mining would cover only six-tenths of one percent of the state general fund budget.

e. Revenues to the county governments from the taxes they levy on uranium mining would be about $3.6 million per year. This represents about 5 percent of the two counties’ total budgets but as much as 20 percent of the counties’ general fund budgets. The new uranium mining industry, its workforce, and the increase in population, however, would also impose additional costs on the county government. There will be a net fiscal gain to the county governments only if the cost of the additional services is less than the increase in tax revenues.

f. In sum, the economic impacts of a renewed uranium boom would be quite modest at best. At the state level the impact would be almost imperceptible. At the local level it would make a difference, boosting both county revenues and county costs to deal with the impacts of renewed mining, but would not in any sense transform the local economies. In both cases the impact would be temporary, until uranium mining retrenched or shut down again. See Section V.

8. Communities and regions that have been successful at attracting significant amounts of new economic activity over the last two decades were not those that continued to specialize in natural resource extraction. In fact those areas lagged all other community economic categories. As economic activity in the American economy has become relatively more mobile, a different set of local characteristics, other than the presence of extractable natural resources, has become important in determining the location of economic activity: the quality of the local labor force, the quality of the public infrastructure, including schools, parks, and libraries, and the quality of the social and natural environments. Areas that are perceived to have the human, public, and environmental resources and amenities that make them attractive residential locations have prospered. See Section VI.

   The Grants area can do the same. Cibola County is already a retirement destination county because of its attractive qualities. The ongoing growth in employment, real income, and population despite the disappearance of uranium mining and the loss of 90 percent of metal mining jobs overall in New Mexico makes clear that the Grants area and New Mexico <u>can</u> compete as the location of new economic activity. New Mexico’s presentation of itself to the rest of the nation and the world as the “Land of Enchantment” — rather than the land of uranium and copper mining or other industrial activities —sends the message that New Mexico understands the importance of natural and cultural amenities to its continued economic vitality.

The State of New Mexico and Cibola and McKinley counties, after suffering through the expected dislocations and adjustments, successfully "digested" the uranium "bust" of the 1980s and moved on to diversify their economies and expand the range of economic opportunity. The near disappearance of uranium mining and milling did not create ghost towns or permanently disable the state or local economies. Unemployment rates are low, real incomes are rising, and jobs are being created. In that sense, the New Mexico and the Grants area local economies are not irretrievably depressed and in need of rescue by another uranium boom. Citizens of New Mexico communities can afford to be critical, discriminating decision makers who weigh the benefits and costs of a renewed uranium boom.

The social costs associated with uranium mining and processing will remain significant. New Mexico has had intimate experience with the health consequences of past uranium mining practices. New Mexico also faces an enormous negative legacy associated with abandoned mines and very large mines that ultimately will be closed and have to be reclaimed as much as is physically possible. New Mexico and its mining communities have repeatedly suffered through the booms and busts associated with metal mining and its instability due to the volatility of worldwide metal prices. Renewed dependence on uranium mining will expose communities once again to this disruption.

Uranium mining, like all metal mining, is a landscape-intensive activity that almost always has had significant negative impacts on the natural environment. That means that it has the potential to damage one part of the local economic base, environmental quality, while developing another, the mineral deposit. To the extent that the environmental damage could be significant and near permanent while the mineral development, in contrast, is a relatively temporary "boom," significant public economic policy issues are raised: What are the long term public costs of renewed uranium mining? What are the long term benefits, if any, of the metal mining roller coaster? Is there a net gain or loss to the local economic base as a result of developing the uranium deposits?

The environmental record of uranium mining, including that of many mines closed at the end of the last uranium boom, clearly indicates that these questions must be explored carefully and critically. This is not "merely" a matter of aesthetics or an impractical effort to preserve "prettiness." It goes to the heart of the future economic vitality and sustainability of the Grants area and New Mexican economies. That is the reason that a rational review and the careful public regulation of uranium mining must be an important part of New Mexico's economic development policy as well as its environmental policy.

I. The Revival of Uranium Mining in New Mexico: A Bonanza or Just Speculation?

Because of the unusually high uranium prices during the 2006-2008 period, there has been much speculation in the New Mexico news media about a dramatic revival of uranium mining and milling in New Mexico. A recent report commissioned by the Uranium Producers of New Mexico and carried out by the Arrowhead Center at New Mexico State University ("Arrowhead report") projects a return to the uranium boom of the 1955-1985 period.[1] After a five-year period of investment in the construction of new mines and mills, that report projects 30 years of uranium mining that would develop almost all of the uranium reserves that the U.S. Department of Energy estimates are found in New Mexico. Annual production over the 30-year period, 2012-2042, would average 10.4 million pounds of uranium per year, almost identical to the rate of production during the 1955-1985 period in New Mexico.[2] The value produced by the new uranium boom was projected to be close to $30 billion dollars and the employment impact an astonishing 249,000 jobs.[3] Given that the total output of the New Mexico economy (GDP) in 2007 totaled $61 billion and the total number of employed persons in New Mexico in 2008 was about 936,000, this would suggest a major expansion in the New Mexico economy.[4] As high as these projected impacts of renewed uranium mining in New Mexico are, they are actually somewhat modest compared to earlier industry projections that $67 billion would be generated by renewed mining that would produce 600 million pounds of uranium, nearly twice the estimated New Mexico reserves.[5]

The Arrowhead Report calculates the potential value of New Mexico's uranium reserves by multiplying the total estimated reserves by an estimate of the long run price of uranium, e.g. 341 million pounds of uranium reserves valued at $100 per pound = $34.1 billion.[6] Alternatively the value of production is estimated by multiplying the total amount expected to be produced by the estimated average cost of producing it, e.g. 315 million pounds at a cost of $50 per pound = $15.75 billion in production expenditures.[7]

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[1] "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.

[2] 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.

[3] 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.

[4] New Mexico GDP in 2008 from http://www.bea.gov/newsreleases/regional/gdp_state/2008/xls/gsp0608.xls .Civilian employment to which military employment has been added from http://laser.state.nm.us/admin/gsipub/htmlarea/uploads/ta2008.pdf

[5] Lenderman, A. "New Mexico's $67 Billion Bonanza," ***The New Mexican***, April 15, 2007, p. A-7. Also see Uranium Producers of American, http://www.uraniumproducersamerica.com. "New Mexico's $67 billion bonanza" link to the April 15, 2007 article in The New Mexican was still on the UPA home page on August 28, 2008.

[6] Arrowhead Report, op. cit. P. 6.

[7] Ibid. P. 8.

There are many ways in which this type of calculation is misleading, significantly exaggerating the likely economic impact of a revival of uranium mining in New Mexico.

- The 341 million pounds of uranium represent all of the known economically viable reserves in New Mexico. That amount is projected to be extracted over 30 years. So the $34.1 billion is a cumulative, *gross value* that could be generated over an extended period of time into the future. The actual average annual "value" produced would be $1.1 billion.

- The $34.1 billion estimate is based on a $100 per pound price. The Arrowhead Report, in most of its calculations, uses a long-run contract price of $90 per pound. But the spot market price of uranium fell to a low of $46 per pound in October 2008. Industry commentators are projecting long-term contract prices in the $65 range, not the Arrowhead Report's $90 to $100 range.[8] See Figure 1. As will be discussed below, uranium prices, like all commodity prices, are volatile and projecting that a temporary peak price will remain in place indefinitely is quite misleading. The $90-$100 used in this calculation is no more legitimate than using the $136 value from July of 2007. The October 2008 price was only a third of that earlier peak value and only half the value used in the Arrowhead Report. Adjusting for the October 2008 value of uranium, the annual "value" produced would be $523 million per year, not $1.1 billion.

- Even the $523 million figure is simply the **gross *value*** of the uranium produced, ***not the economic value received by New Mexicans***. The production payroll associated with uranium mining and milling represented only 12 percent of the value of the uranium produced in 2002.[9] That is, less than an eighth of the value of the uranium would flow to workers in New Mexico. That would represent about $89 ***million*** per year, only about **thee-tenths of *one percent*** of the $34 ***billion*** dollar figure, and less than two-tenths of one percent of New Mexico's 2006 personal income.[10] Much of the total value of the uranium would flow out of state

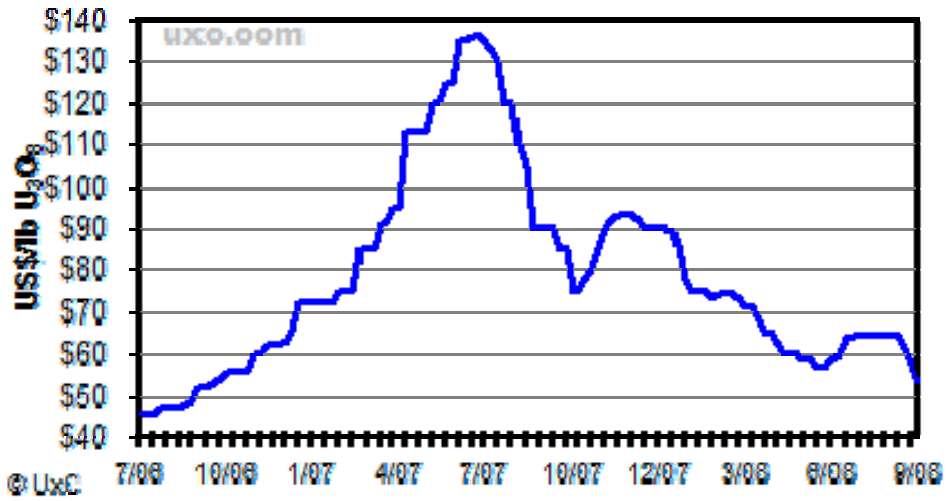
[8]See, for instance, ***Mining Weekly Online,*** April 4, 2008, http://www.miningweekly.com/article.php?a_id=129299 accessed August 28, 2008. Also see ***Ux Weekly,*** April 7, 2008, 22(14), which reported projections of a long-term bottom or equilibrium spot price in the $40-$60 range (p. 1). ***Ux Weekly*** also reported that most buyers and sellers of uranium (64 percent)did not believe that the long-term contract price as reported by various consulting firms was a good indication of future uranium prices (pp. 2-3). The ***Nuclear Review*** recently (July 2008) pointed out that since 1996 the long-term contract and spot market prices have tracked each other closely. The diverged in 2007 as spot market prices rose steeply to about $140 per pound while long-term contract prices leveled off in the $90-$100 range. As spot market prices tumbled down towards $60, contract prices continued at about $90 but then began to decline modestly too (Figure 1, p. 13). For all of these reasons we have emphasized the spot market prices as more indicative of the instability in uranium markets and current downward pressures on prices.

[9] 2002 Economic Census, Mining, Uranium-Radium-Vanadium Ore Mining 2002.

[10] The Arrowhead Report estimates that mine and mill worker income would represent 28 percent of the value of the uranium produced in New Mexico, over three times the data reported by the federal government for 2002. As will be discussed below, the higher Arrowhead number is tied to the use of labor productivity taken from mine and mill operations in the 1970s, over three decades ago. Technological

to those who put up the capital for the exploration and development of the mines and mills, as profit to the companies doing the mining, to pay for the equipment used in the mining, most of which is not manufactured in New Mexico, and to cover other out-of-state costs. Just the depreciation of the mine and its equipment would be half again more than the total New Mexico payroll associated with the uranium mining.[11]

Figure 1: Spot Market Uranium Prices
July 2006-September 2008



Clearly the direct impact of renewed uranium mining in New Mexico would have an annual impact on the residents of New Mexico that is significantly smaller than the industry figure of $34 billion would suggest. On the other hand, the discussion above focuses only on the *direct* impacts just as the $34 billion figure does. It ignores "ripple" or "multiplier" impacts. Even if those increase the impacts by a factor of two to three, the impacts on the state and local economies will be quite modest. More detailed estimates of those impacts are developed in Section V below.

However, it is noteworthy that the above "best case" scenario, especially its timing, is unlikely. The industry projection is that between 2008 and 2012 15 mines and three mills will be constructed in New Mexico. By 2012 large scale uranium mining would be underway. But as of July 2008, there were no permitted or proposed mines or mills other than Hydro Resources Inc.'s Crownpoint Uranium Project. The industry forecast of

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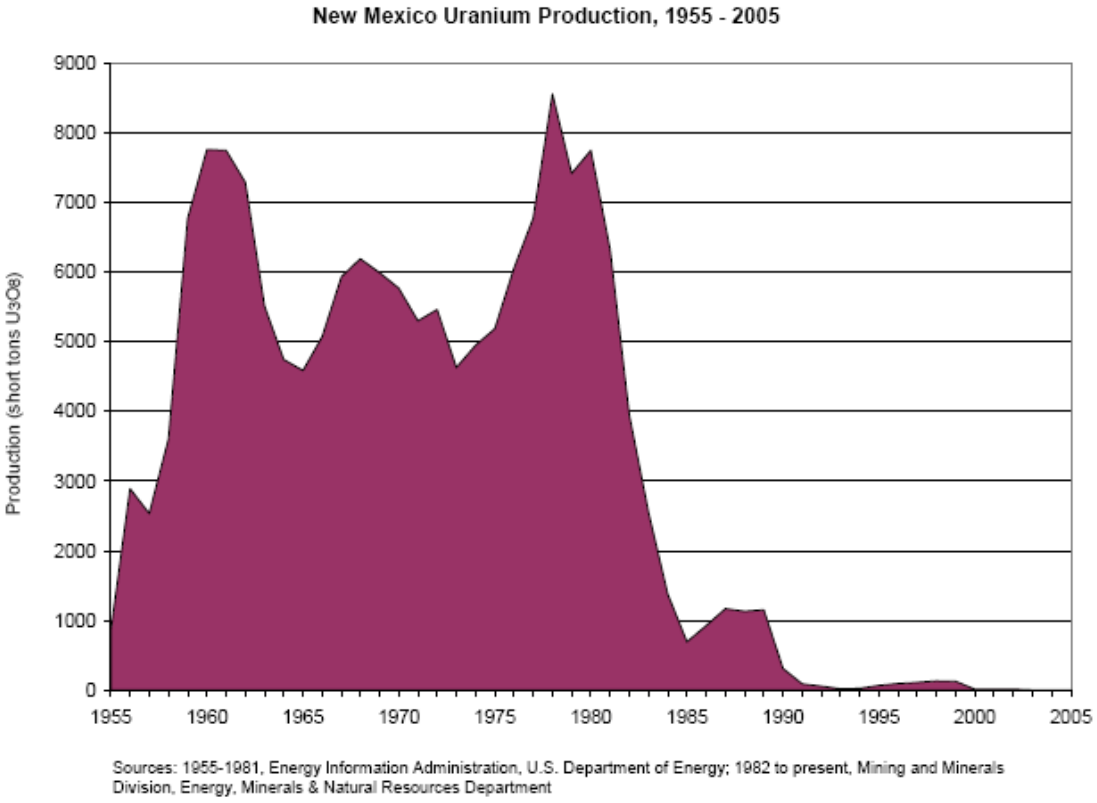
change in uranium production since then has significantly reduced the amount of labor used. *In situ* chemical extraction of uranium, the only licensed uranium mining proposal in New Mexico currently and the only type of uranium mining currently taking place in the United States, is an example of this labor saving technological change.

[11] Additionally, royalties may be paid to landowners, and state and local governments will receive part of the value as a result of taxes. If mining stretches over a 30-year period, the total property and severance taxes would be about $25 million per year, under the industry's unrealistic scenario.

rapid build out of a uranium mining and milling infrastructure in New Mexico over the next four years is not going to happen. Whether it happens many years into the future will depend on whether New Mexico can out-compete other uranium producing areas in the United States, the many uranium producing countries around the world, and the secondary sources of nuclear fuel controlled by political choices the American and other governments make. The fact that New Mexico has not been able to operate uranium mining and milling facilities over the last two decades while other American and foreign competitors have does not support the hypothesized imminent uranium boom in New Mexico.

Figure 2

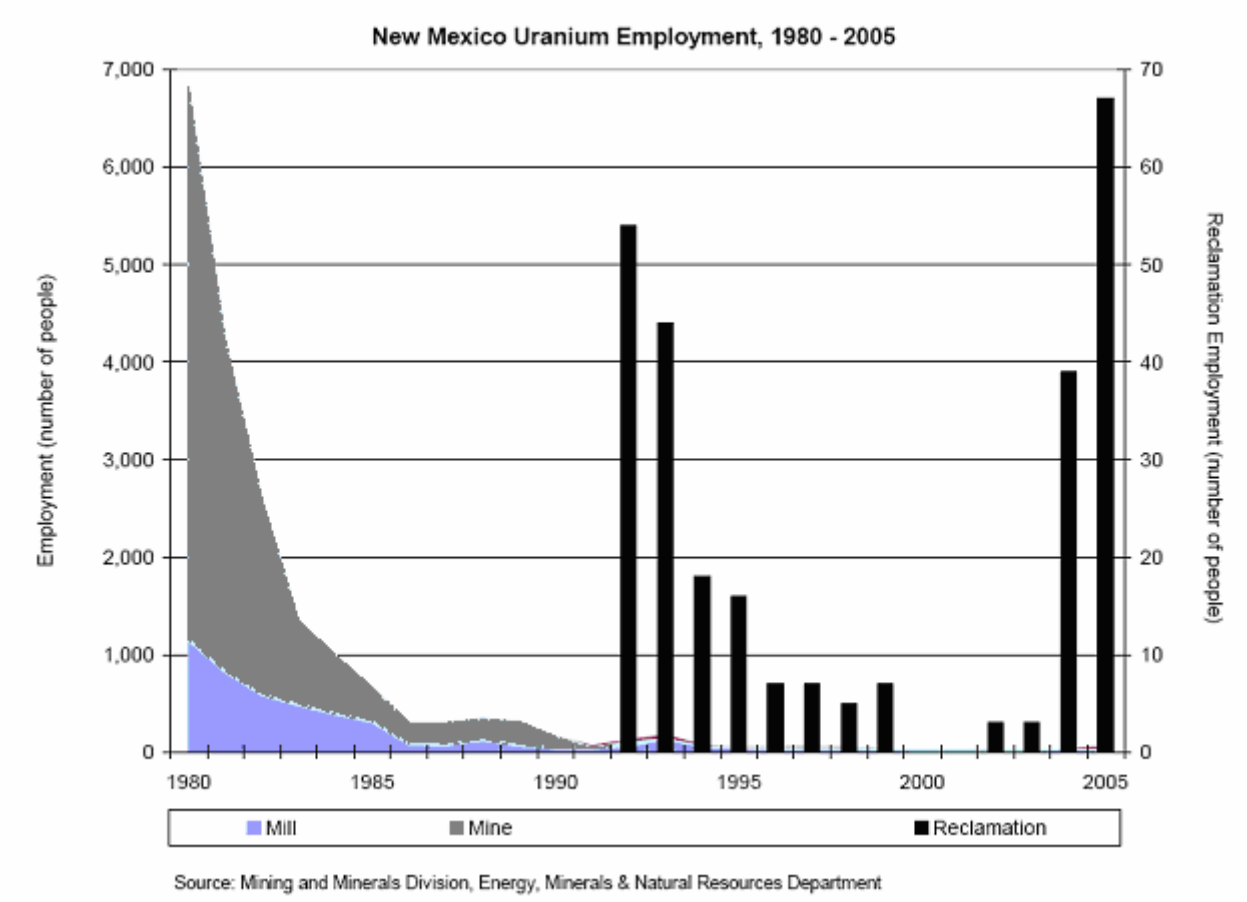


II. Instability in the Uranium Industry

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 almost a complete shut down of uranium mining. See Figure 2 above.[12]

[12] Source: New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division http://www.emnrd.state.nm.us/Mmd/MRRS/documents/Uranium.pdf , p.2.

Figure 3



In 1980, at 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. In 2005 the only people employed in uranium operations in New Mexico were the 67 employed in the reclamation of old mine sites. See Figure 3.[13]

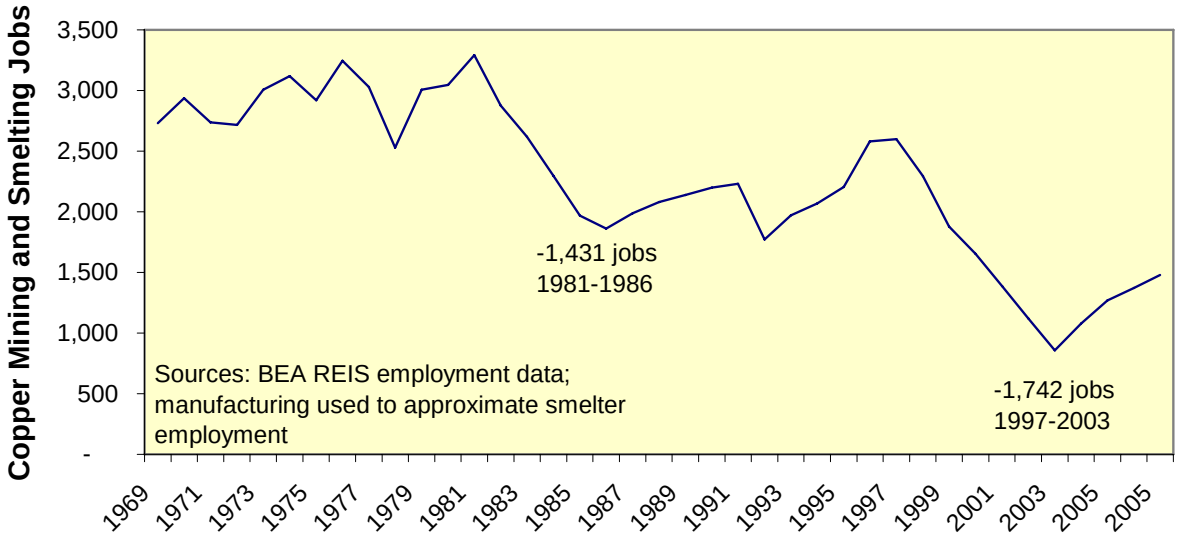
It was not only uranium ore mining and processing that suffered major reverses in the early 1980s, and it was not only in New Mexico. Copper mining and smelting also largely collapsed in New Mexico, Arizona, Montana, Utah, and Michigan. The iron mining industry of Minnesota and Michigan also largely shut down.

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, or 30,000 jobs. In addition, many copper smelters shut down, laying off many thousands more copper workers. In the Silver City area of New Mexico, about

[13] 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.

1,400 copper jobs were lost in the early 1980s. By the early 2000s another 1,000 copper jobs had been lost. See Figure 4.[14]

Figure 4: Copper Industry Employment, Grant County, NM



Other American metal mining operations also scaled back or shut down operations during the 1980s and 2000s. Taconite iron ore production, for instance, in the Iron Range of northeast Minnesota plummeted, laid off 9,000 workers between 1979 and 1983. By 2005, 83 percent of iron mining jobs had been lost, about 11,000 in total. See Figure 5.

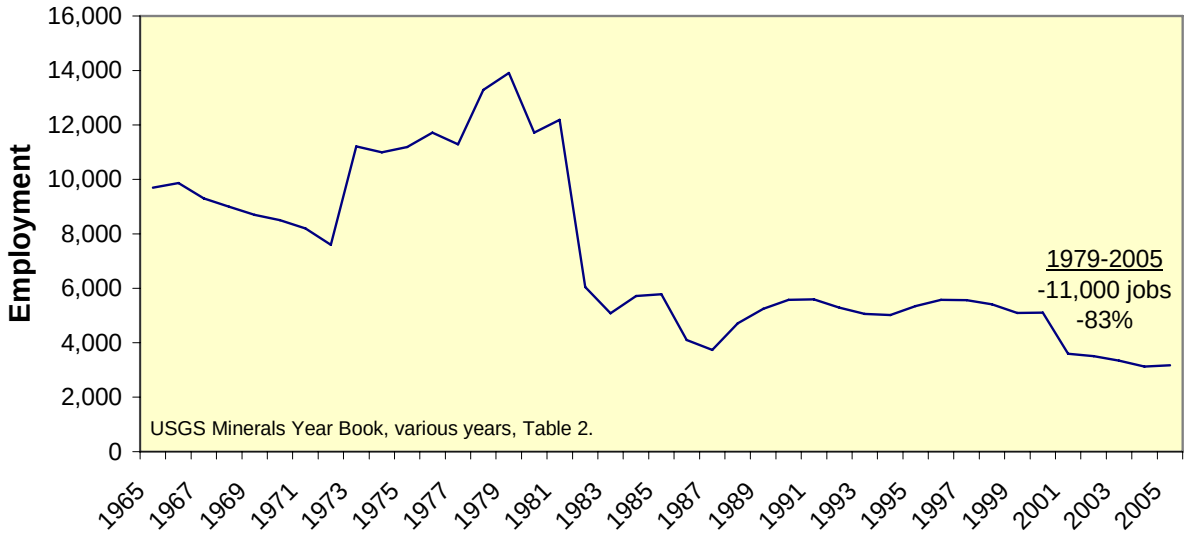
The reason for discussing the declines in uranium, copper and iron mining at the same time is to underline the fact that there were international economic forces operating that affected metal mining nationwide. As the United States' economy was increasingly integrated into the world economy, American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

This is a familiar pattern in metal 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.

[14] 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. 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 the state. The Grant County data shows 400 mining jobs added between 2006 and 2007 and 150 jobs added 2005-2006.

Figure 5

Employment in Minnesota Iron Ore Industry: 1965-2005



That price and production pattern 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 and uranium prices plummeted. See Figure 6. 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 in mind in evaluating the current price for uranium along with many other metal prices including copper. If uranium prices are adjusted for inflation (i.e. converted to "real" prices), current uranium prices are not unprecedented. They were as high or higher in the 1970s at the time of the last uranium boom in New Mexico, just before the bust of the 1980s. Figure 7 contrasts such "real," inflation-adjusted prices with the actual ("nominal") prices. Also note the continued volatility in uranium prices: They fell 55 percent from their mid-2007 peak of $135 per pound to $46 per pound in October of 2008. But those high prices in 2007 led to half of all new mining claims on New Mexico BLM lands to be uranium claims. However, between January and July 2008, since uranium prices have fallen, only two new exploration permits for uranium have been filed with the New Mexico Mining and Minerals Division.[15]

Also note that the real price of uranium was at $90 and above for only five years in the late 1970s and for less than one year in 2007. Yet the Arrowhead Report projects that going forward that price will be $90 or more for 30 years into the future.

[15] http://www.emnrd.state.nm.us/mmd/MARP/MARPNewPermitApplicationsandCloseoutPlans.htm

Figure 6: Uranium Price and U.S. Production

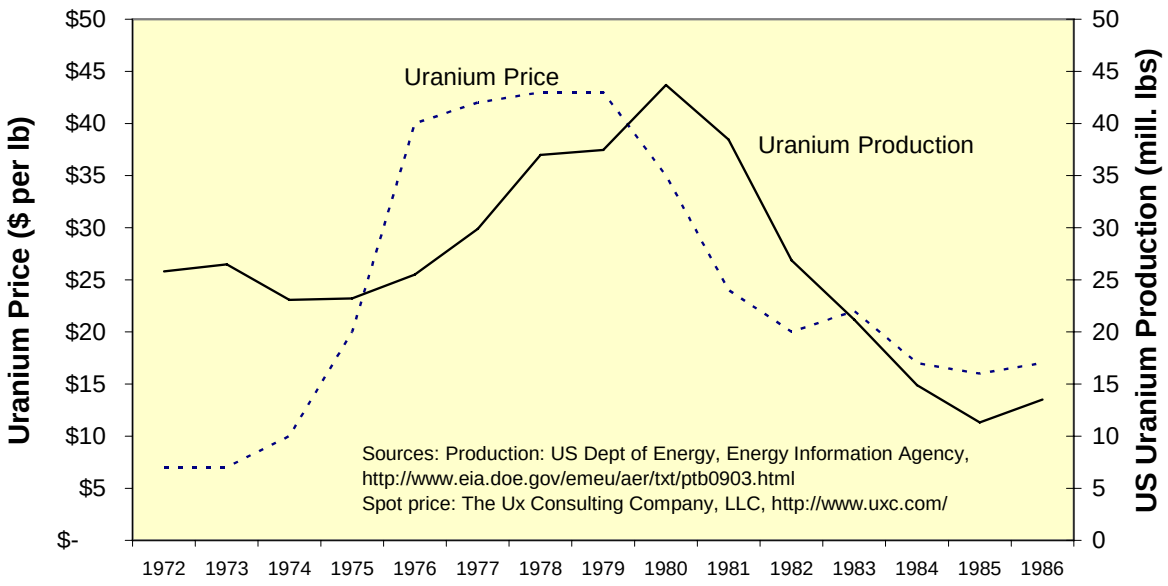
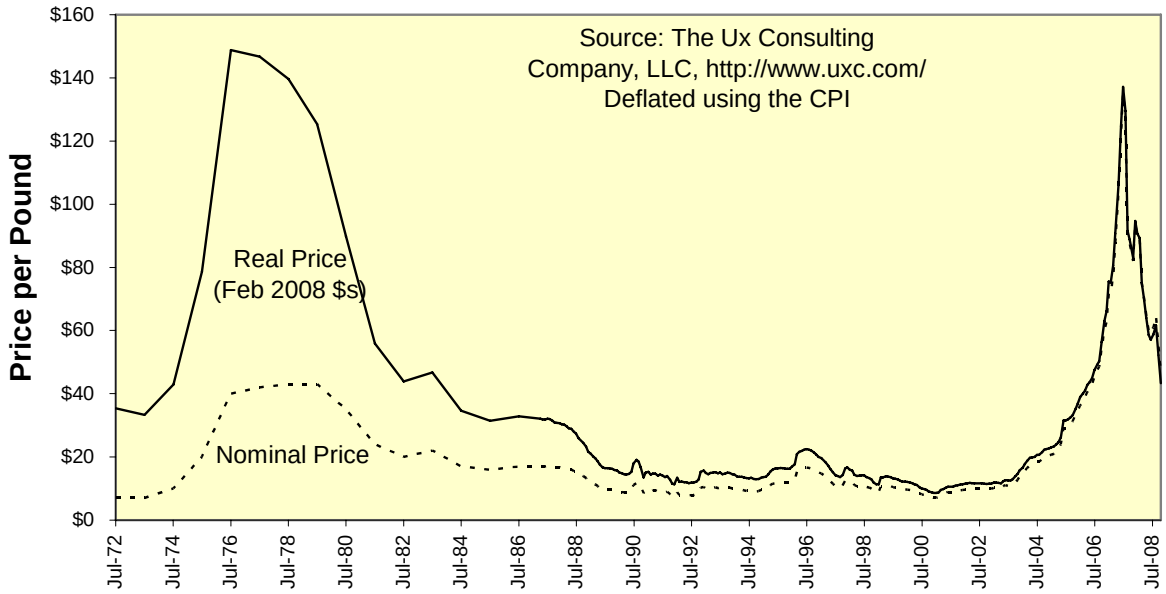


Figure 7: Uranium Oxide Spot Market Prices: Real and Nominal



Very low uranium prices between 1983 and 2003 and a *de facto* moratorium on the building of new nuclear power plants led to a contraction of the uranium mining and milling industry. Mines and mills in New Mexico and elsewhere in the United States and around the world were abandoned and the mills actually dismantled. Existing nuclear power plants were largely fueled by industry stockpiles and then by the release of government-owned supplies of nuclear material following the end of the Cold War.

Russian surplus weapons materials and American strategic stockpiled nuclear materials were released for use in existing nuclear electric generating facilities.

More recently as the number of planned new nuclear generating stations announced around the world was expanding, major uranium producing facilities were shut down due to accidents in Canada (flooding at the Cigar Lake mine) and Australia (fire at the Olympic Dam solvent extraction plant). Uncertainty about the continued availability of nuclear materials from government-controlled secondary sources also raised questions about the adequacy of nuclear fuel supplies. Given the long lead time involved in restarting uranium mining and milling in areas such as New Mexico, where it was abandoned, uranium prices began to rise steeply in 2004 as existing nuclear facilities stockpiled fuel as a hedge against higher future prices. This, too, added to the upward pressure on prices during the first half of 2007. During the second half of 2007 and the 2008, however, uranium prices tumbled, losing more than two-thirds of their mid-2007 value. By October of 2008 the price was $46. See Figures 1 and 7 above.

Because there is not an organized uranium market in which uranium is bought and sold in a relatively transparent manner, there is less information available and more uncertainty than, for example, in gold or copper markets. Most uranium transactions involve private bilateral deals. In addition, government decisions control a significant part of the overall supply of nuclear materials. Private consulting firms estimate both spot market and average long-term contract prices. This adds to the uncertainty and makes the uranium market particularly susceptible to speculative swings in apparent prices.[16]

From a longer run point of view (the next 10 to 20 years), there was no reason to believe that uranium prices would remain as high as they were in mid-2007. There is no shortage of known uranium ore deposits around the world. The International Atomic Energy Agency (IAEA) estimates that there are sufficient conventional uranium reserves to power the existing nuclear plants for 85 years. If other, less certain, uranium reserves are included in the count, hundreds of years of supply are projected to be available.[17] Technological advances in nuclear reactor design could considerably expand that effective 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.[18] The rest remains in the highly radioactive waste materials that have to be disposed of.

[16] UxC Consulting publishes the UxC Weekly and TradeTech publishes The Nuclear Market Review. See footnote 8 for a discussion of the reliability of long-term contract price estimates and the relationship between spot and long-term contract prices.
[17] Uranium 2005: Resources, Production and Demand, International Atomic Energy Agency, www.iaea.org/NewsCenter/News/2006/uranium_resources.htm.
[18] 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.

The conventional supplies of uranium ore available for development around the world are extensive. The United States has a relatively small part, about 7 percent, of those reserves. Australia has about a quarter and Kazakhstan almost a fifth of the 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 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.[19] That could put American uranium mining development at a competitive disadvantage as countries and nations rush to develop their uranium supplies to take advantage of the current high uranium prices.

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.[20] The World Nuclear Association (WNA) reported that 45 percent of the uranium consumed in the world in 2005 came from secondary sources, and that 35 percent of uranium used in 2010 would be from secondary sources.[21] While current policies and laws of the U.S. restrict the volume of uranium that can be released from government stockpiles or "blended" with weapons-grade uranium to make reactor fuel, changes in such government policies could free up substantial quantities of uranium to offset or replace the need for new mining here and abroad.[22] 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 1990s. These secondary sources will continue to impact the viability of new uranium mines in the United States for the foreseeable future.

In conclusion, uranium mining, like other metal mining, tends to be an unstable industry prone to booms and busts. New Mexico knows this well since it has lived through one major uranium boom and bust and has also had the same experience with copper and other metal mining. Even before the more recent expected "boom" in uranium mining and processing got under way in New Mexico in 2008, uranium two-thirds half of its peak value. Mining industry instability makes the potential employment, payrolls, royalties, and taxes associated with uranium mining uncertain and risky. New Mexico will be competing with other areas in the United States and around the world to expand uranium mining and processing to take advantage of the current prices. Given the relatively low quality and high cost associated with New Mexico's and other American uranium supplies, it may well be that New Mexico's new supplies will become

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[19] Uranium Resources and Nuclear Energy, Energy Watch Group, EWG-Series No. 1/2006, December 2006, http://www.energywatchgroup.org/fileadmin/global/pdf/EWG_Uraniumreport_12-2006.pdf , Figure 3, p. 11.

[20] "Secondary Supplies: Future Friend or Foe, James C. Cornell, World Nuclear Association 2005 Symposium http://213.198.118.156/sym/authidx.htm .

[21] Also see "Need or Greed? Uranium Prices and Demand." Robinson, W.P, *Voices from the Earth*, 7(3), Fall 2006. http://www.sric.org/voices/2006/v7n3/Need_Greed.html

[22] Ibid. As with any nuclear technology, including uranium extraction and enrichment, down-blending presents a risk of nuclear proliferation.

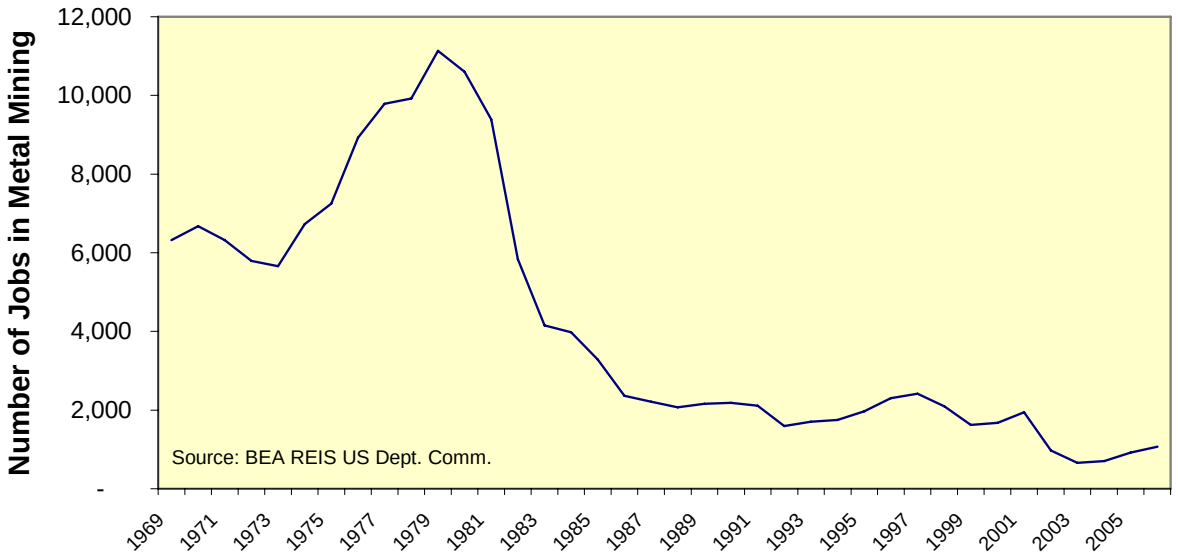
uneconomic as countries with larger and lower-cost supplies, such as Kazakhstan, bring large increments of supply on line. In addition to the production from existing and new mines, large amounts of uranium from secondary sources could be released to the market if currently restrictive government policies are eased. 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 the rush to rebuild an extensive uranium mining infrastructure, it may well ride the uranium mining roller coaster once again.

III. The New Mexico and Local "Uranium Economies" Rebounded After the Last Uranium and Metal Mining Industry Collapse

A. Statewide View

Employment in New Mexico uranium mining began to plummet in 1980. Between 1980 and 1986, 6,400 jobs were lost in mining and milling. See Figure 3 above. Employment in copper mining also declined during the 1980s. As a result, by 1993 metal mining employment in New Mexico had fallen by 9,500 jobs. See Figure 8.

Figure 8: Metal Mining Jobs in New Mexico



Despite this massive loss of jobs in a historically important sector of the New Mexico economy, the rest of the economy, outside of metal mining, was able to expand significantly. Despite the loss of 10,000 jobs in metal mining between 1979 and 2006, the rest of the New Mexico economy added about 500,000 jobs, generating 50 new jobs for each metal mining job lost. In addition, while real earnings in metal mining declined by 85 percent between 1980 and 2000, real income from other sectors of the New Mexico economy grew by 75 percent. See Figure 9. Clearly there were other major sources of economic vitality within the New Mexico economy other than metal mining

that helped absorb the losses in metal mining and allowed the rest of the economy to continue to expand.

Part of the reason for the resilience of the New Mexico economy in the face of these massive job losses in uranium and other metal mining was that metal mining had become a relatively small source of income in the overall economy. In 1979, just before the beginning of the uranium and copper employment declines, metal mining was directly the source of only 3 percent of total personal income in New Mexico. As metal mining shrank and the rest of the economy expanded, metal mining became the source of only a tiny fraction of total personal income, 0.2 percent or one dollar out of every five hundred being received by New Mexicans. See Figure 10.

Figure 9
Trends in Metal Mining and the Rest of New Mexico Real Income

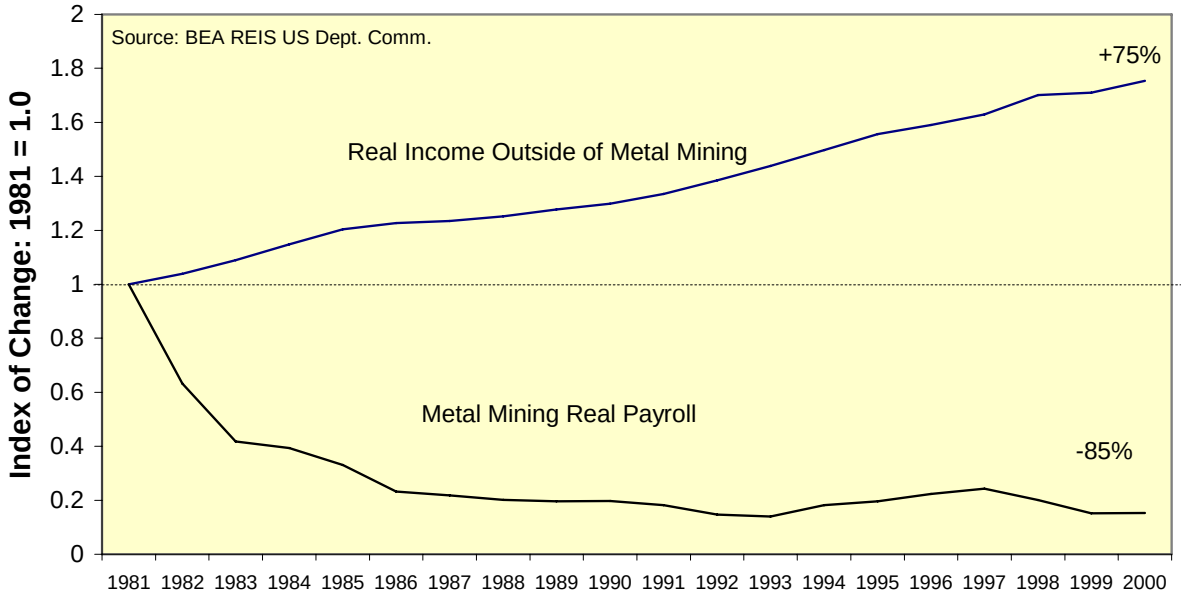
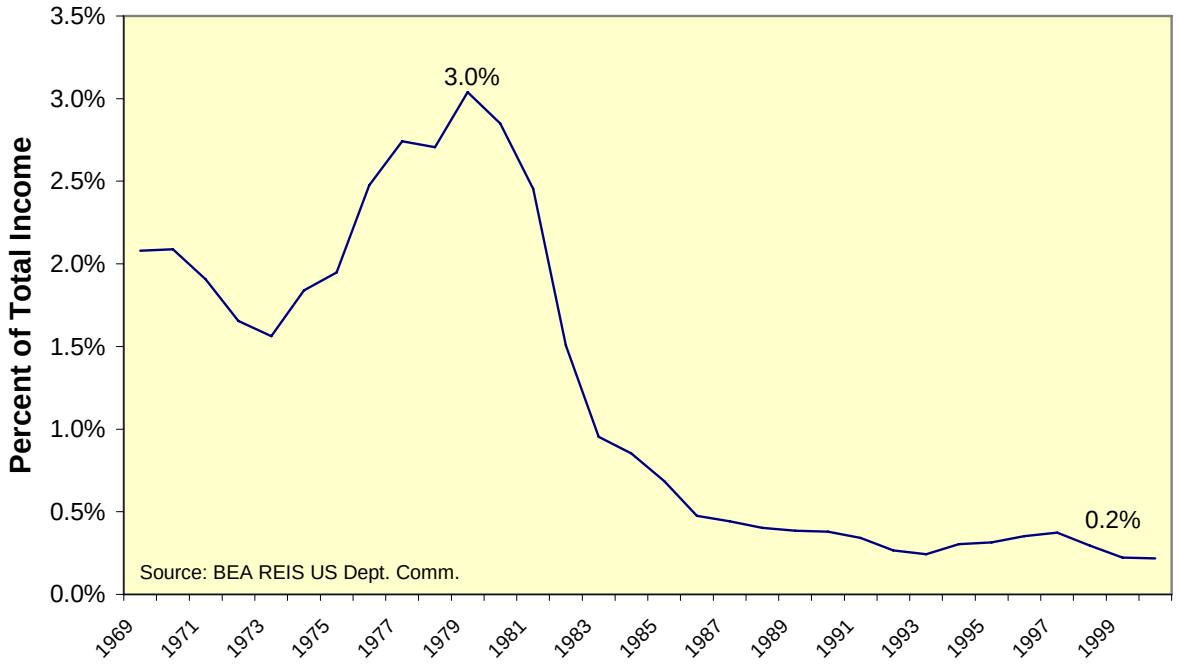


Figure 10: Metal Mining as a Source of Income in New Mexico



Clearly the decline in the uranium mining industry and other metal mining activities after 1980 did not seriously cripple the New Mexican economy. Indeed, as illustrated in Figure 11, total real income being earned by residents increased by 124 percent. Jobs expanded by 86 percent. Population grew by 53 percent. And real per capita income increased 42 percent. The New Mexico economy had the resilience and vitality to digest the job losses in those metal mining sectors and continued to expand. See Figure 11. Metal mining was not the engine that was driving the New Mexico economy.

The growth in the New Mexico economy was driven by job creation in a broad variety of different industries. The sectors with the fastest growth between 1990 and 2006 are shown in the Table 1 below.

Although some of the sectors with significant job growth are those that have gotten a lot of attention as low-paid jobs (retail trade stores and restaurants), the construction industry provides well-paid blue-collar jobs and health care is the source of a large number of well-paid jobs too. Professional and Technical Services include lawyers, accountants, architects, design specialists, and computer services. Administrative Services includes office administration, employment services, and other business support services. Expanded employment in local government was also a significant part of the growth in total jobs.

Figure 11: Indices of New Mexican Economic Vitality
After the Collapse of Uranium and Other Metal Mining

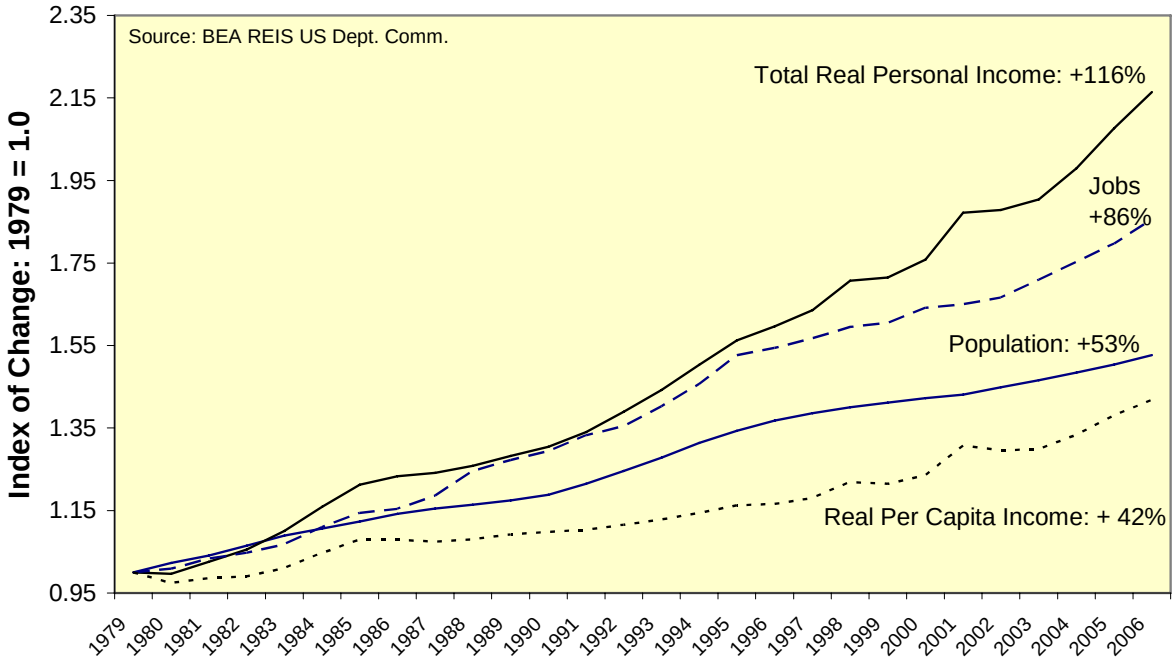


Table 1

Sources of Job Growth in New Mexico 1990-2006	
Industry	Change in Employment 1990-2006
Construction	37,000
Retail Trade	29,000
Real Estate	22,100
Professional &Technical Services	23,600
Administrative Services	30,400
Health Care	54,300
Food Service & Drinking Places	23,600
Other Services	18,000
Local Government Employment	35,000
All Other Industries	59,600
Total Change	332,600

Source: US Dept. Comm., BEA, Regional Economic Information System.

B. Local Economic Impacts of the Decline in Uranium Mining

Although the overall state economy may have been large enough to absorb the loss of the jobs in uranium mining, the economies in the local area around the uranium mines and mills might be expected to be considerably less resilient in the face of such job losses. However, close inspection of the local economies most dependent on uranium mining since uranium collapsed reveals this is not the case.

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.[23] Grants, the county seat of Cibola County, and Gallup, the county seat of McKinley County, are the largest cities in that mineralized area. We will use McKinley and Cibola Counties as the local economic area impacted by the decline in uranium mining in the 1980s.

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 Country during the 1970s uranium boom and the beginning of the 1980s uranium bust. As a result, we cannot track the boom and bust in Cibola county the way we can in McKinley County. It should be kept in mind that the Grants area of Cibola Couty was the source of many workers who commuted into McKinley County during the uranium boom there. This meant that much of the income earned in uranium jobs in McKinley County flowed out of that county into the larger economic area. These two counties are economically linked.

Figure 12 shows the impact of workers commuting into McKinley County. The data indicate that the McKinley County uranium mining workforce in the 1975-1985 boom, in general, did not live in McKinley County. As a consequence, the outflow of earnings associated with commuting workers drained the equivalent of two-thirds of the earnings of the metal miners in McKinley County out of that county. This is not unusual. Miners represent a very mobile workforce. The relatively high pay in mining justifies long commutes. That commuting, however, also means that much of the value created by the mining activity is not received by residents of the area around the mine but flows elsewhere.

The uranium mining boom of the 1970s created 6,100 new mining jobs in the three county area.[24] At its peak at the end of the 1970s, mining was the source of 21 percent of all jobs. 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. See Figure 13. Mining provided 38 percent of all labor earnings in the three-county area in 1979, but only 5 percent in 1997.

[23] 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.
[24] For the boom period, Valencia and Cibola Counties were still one county. So the equivalent of Valencia, Cibola, and McKinley Counties' mining employment are reported here.

Figure 12: Real Metal Mining Earnings and Residence Adjustment for Commuting Workers: McKinley County, NM

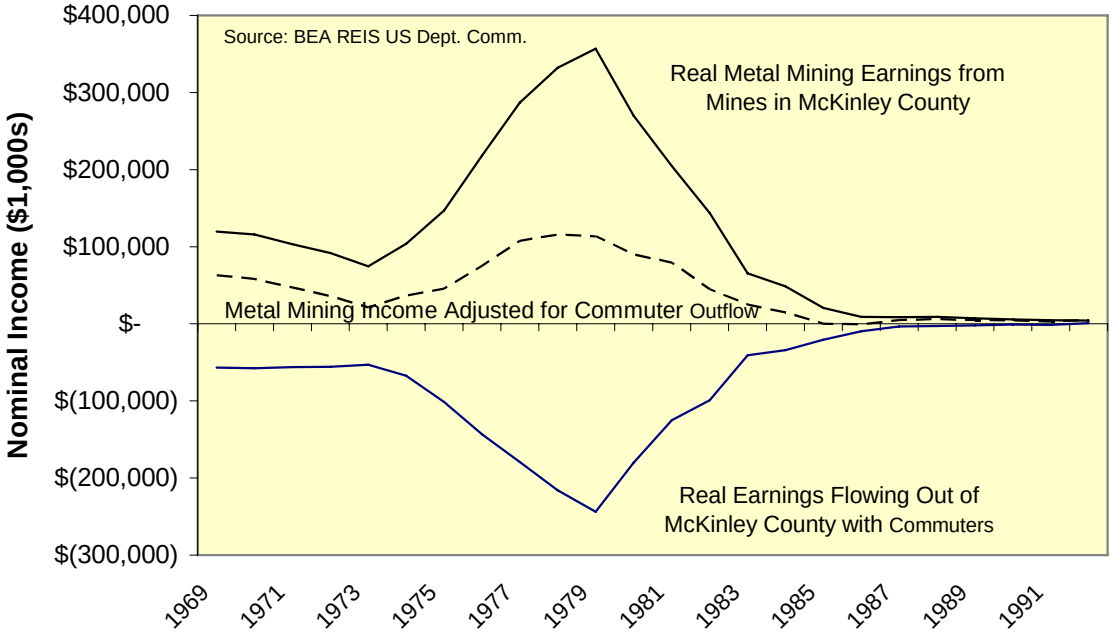
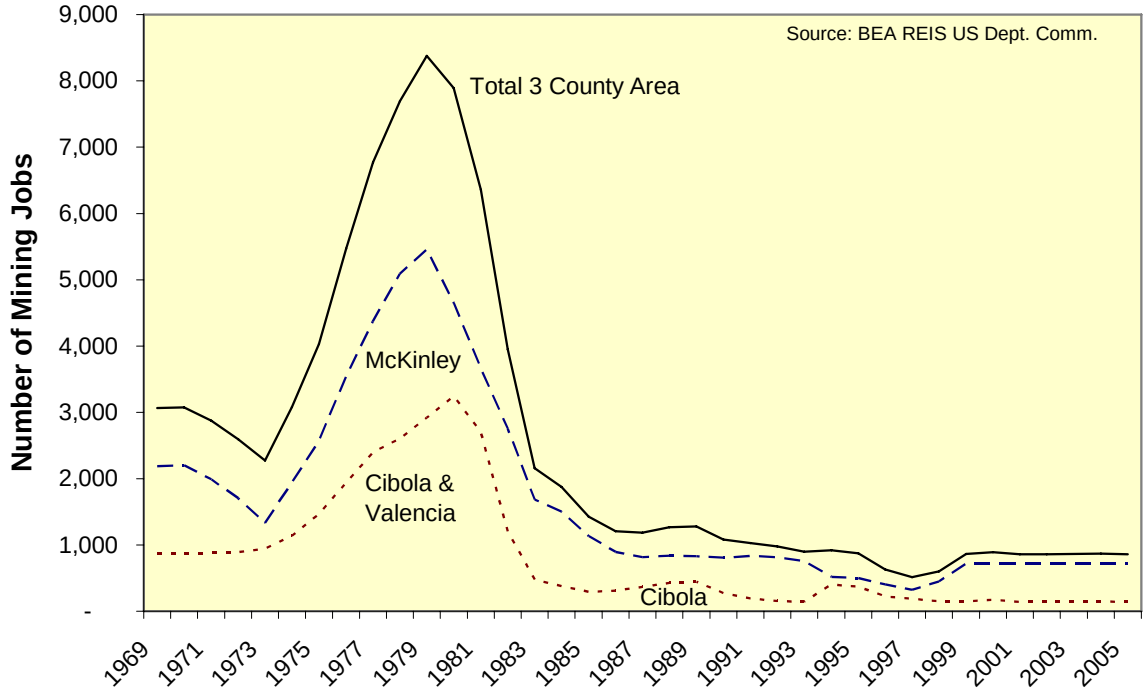


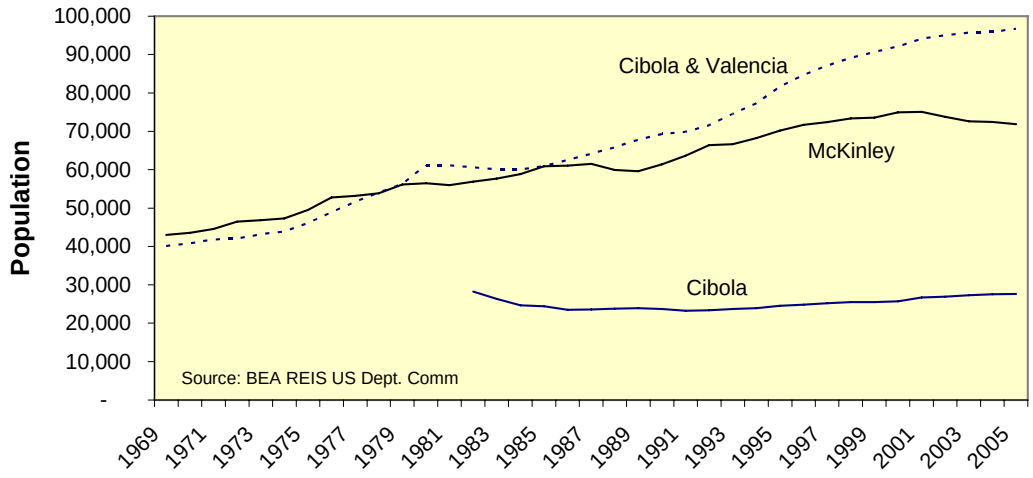
Figure 13: Changes in Mining Jobs in McKinley, Cibola, and Valencia Counties, NM



One might predict that these dramatic changes in mining employment and income would have had a profoundly negative effect on the overall local economy. But, as the data show, quite the opposite is true.

First, the population of these two counties was not much affected by the uranium boom and bust of the 1970s. This was particularly true of McKinley County where many of the workers commuted in but lived elsewhere. In Cibola County, there was a modest decline in population during the bust, then stability and slight growth. In Cibola-Valencia combined, the population grew more steeply during the 1970s and then, during the bust in the early 1980s, remained stable before returning to a growth path. See Figure 14.

Figure 14: Population of McKinley, Cibola, and Valencia Counties, NM



This stability and growth in the area was impressive after it had suffered such a large economic shock. The mining jobs lost during the 1980s represented about a sixth of all jobs in 1979 and a third of all earnings. Yet the population of McKinley and Cibola counties did not plummet dramatically but, instead, after a pause in McKinley and a modest decline in Cibola, population was actually able to grow slightly. Clearly there had to be other sources of employment and income to maintain the population after the loss of such a large number of jobs and the associated payroll.

One part of the explanation for the stability of the local economy 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 then contraction of the uranium industry in the Grants area. The real earnings and other sources of personal income not directly associated with mining continued to grow during the bust just as it did during the boom in McKinley County. There was a very modest decline in the growth of other sources of income *before* the uranium decline began but ongoing growth during the bust. See Figures 15a for the experience in McKinley County and 15b for Cibola County’s experience.

Figure 15a: Impact of Uranium Boom-Bust on McKinley County

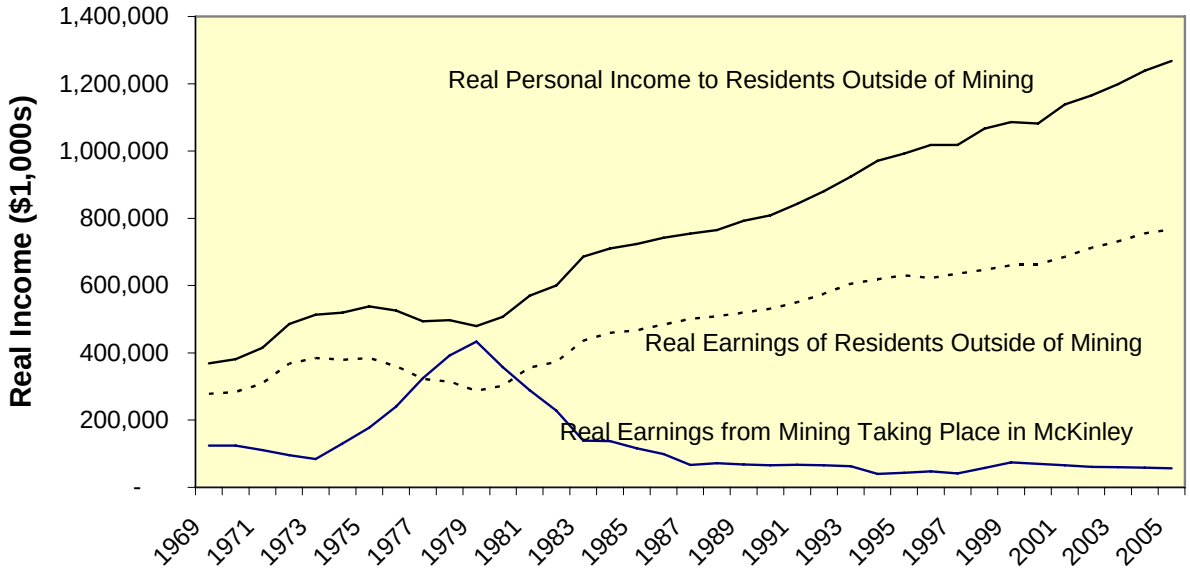
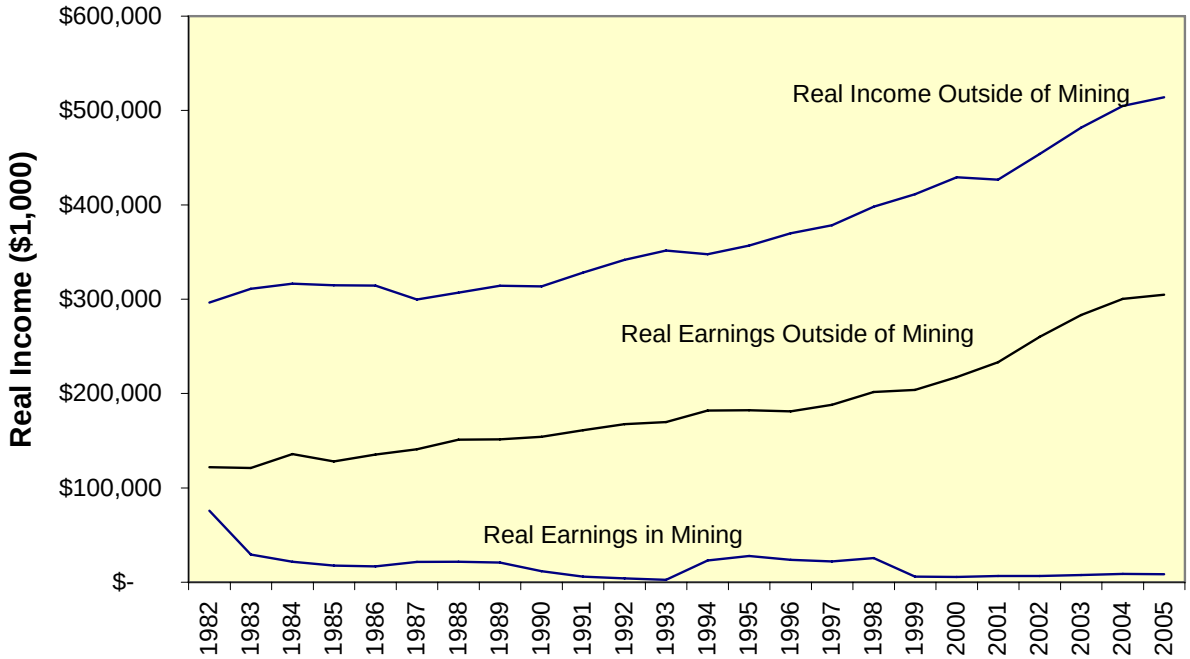
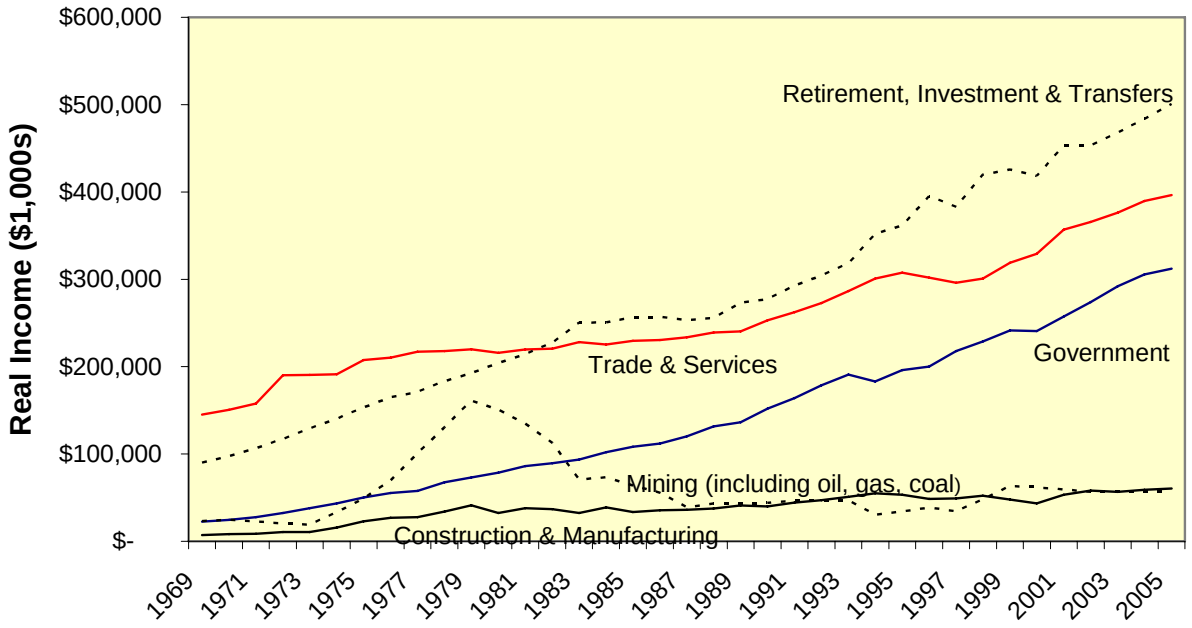


Figure 15b: Mining Collapse and the Rest of the Economy: Cibola



Despite the collapse of the uranium industry, real growth occurred in payroll in retail and wholesale trade, finance, professional and business services, and government.[25] 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" includes 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 Figures 16a and 16b.

Fig. 16a: Trends in Sources of Real Income, McKinley County NM



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. Other sectors, such as agriculture and manufacturing, went through their own cycles with manufacturing expansion supporting the overall economic expansion in the three-country area, including Valencia County, so that the full boom and bust can been seen. See Figure 17.

[25] The "government" income figures in Figure 16 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 and other tribal 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.

Fig. 16b: Sources of Real Income, Cibola County, NM

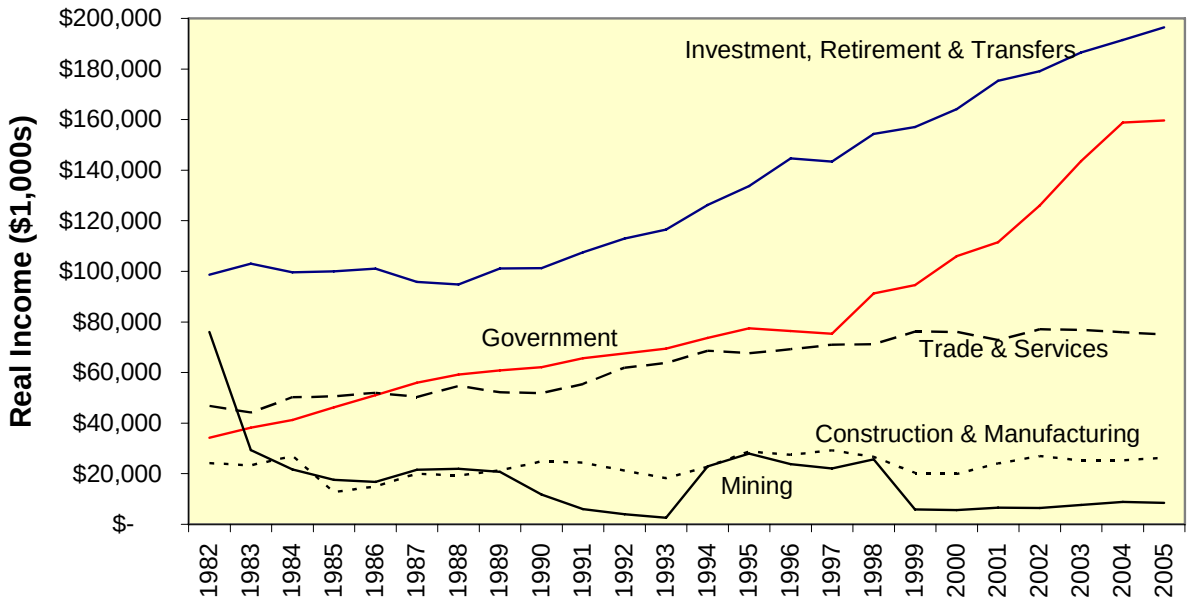
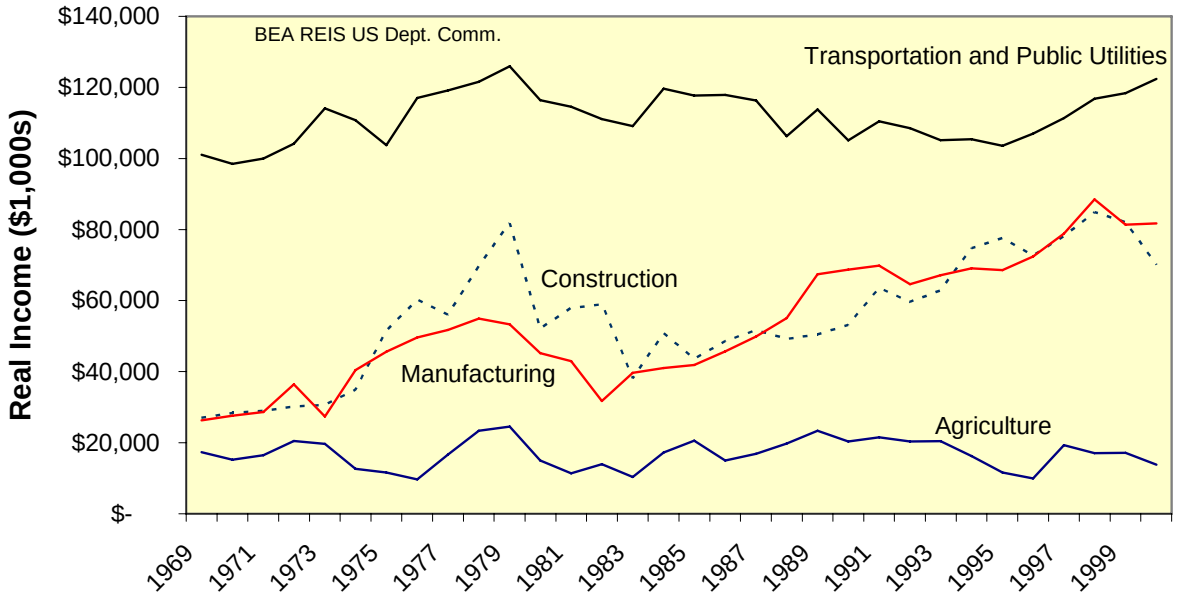


Figure 17: Sources of Real Earnings in Goods Sectors: McKinley, Cibola & Valencia Counties

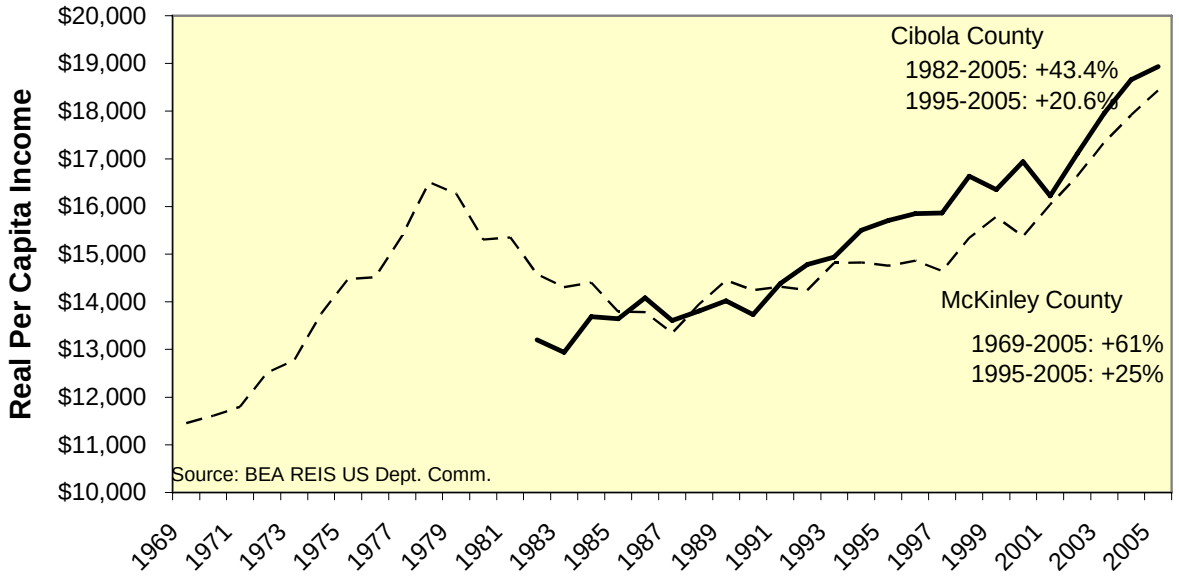


In general, the economies of McKinley and Cibola Counties made quite modest adjustments to the decline in uranium mining and then returned to an expansion path. Mining was neither the source of local economic vitality nor a hindrance to continued

economic expansion. More important, these counties showed considerable success in diversifying their economies in a way that supported ongoing economic vitality.

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, growing by 61 percent in McKinley County between 1969 and 2005 after adjusting for inflation and in Cibola County it grew by 43 percent for the shorter period after the bust for which we have separate data, 1982-2005. However, the gain and then loss of the high-paying mining jobs is apparent in the trends in real per capita income, which rose steeply as the uranium boom of the 1970s developed and then declined as those mining jobs were lost in the 1980s. By 1983, however, real per capita incomes were again rising in Cibola County, although average real incomes did not begin to bounce back in McKinley County until 1988. Over the last 10 years, however, average real incomes have improved by 20 to 25 percent. See Figure 18.

Figure 18: Real Per Capita Income: McKinley and Cibola Counties, NM

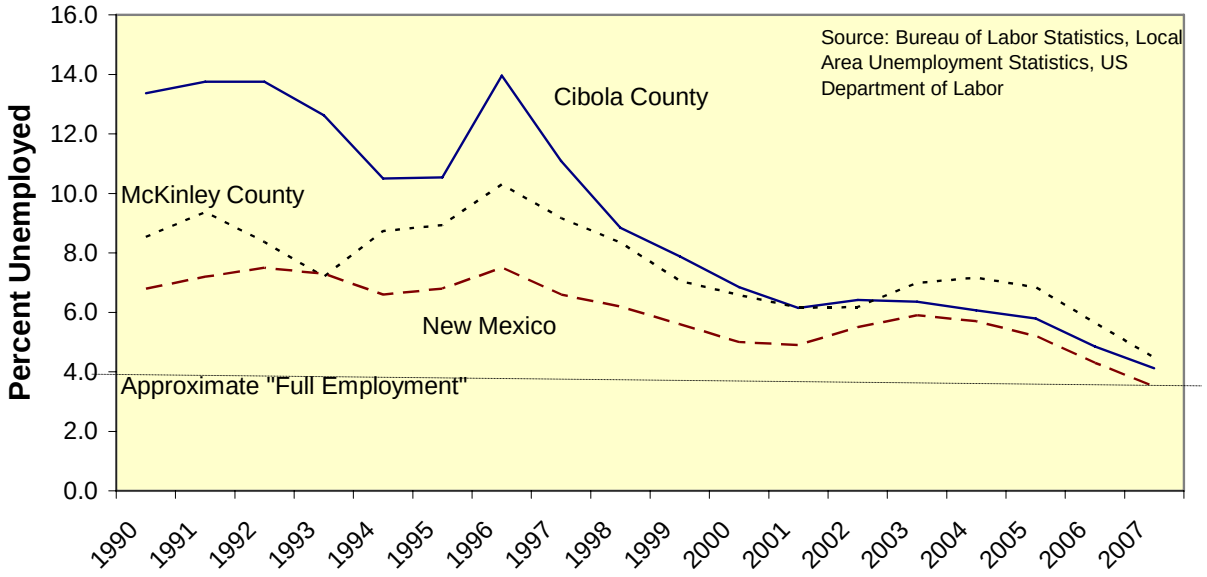


Per capita incomes in these counties, nevertheless, remain significantly below those of the state as a whole. There are two primary explanations for this. First, these are largely rural areas with relatively small cities. Gallup, far to the west, with a population of about 20,000, is the largest city in the two-county area. Grants, the county seat of Cibola County, has about 10,000 people. 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. Second, McKinley County is closely associated with the Navajo Reservation. 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, 40 percent of the total population. The low per capita incomes in those counties also reflect the lower average incomes of Native Americans and their relatively high poverty rates. In 2004,

the poverty rate in McKinley County was 27.4 percent and in Cibola County, 20.8 percent, compared with 16.5 percent for New Mexico as a whole.

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 3- to 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.[26] See Figure 19.

Figure 19: Unemployment Rates in Cibola and McKinley Counties



At least part of the success of the local economies in the Grants area has been tied to the very conscious local effort to redefine the communities and area as something more than a mining-centered economy. Significant post-mining public investments were made in new local infrastructure including the Riverwalk, Mining Museum, Cibola Arts Council facility, new high school, and improved roads. New economic activity 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 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

[26] 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. BothCibola 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.

trails, and the Coyote Del Malpais golf course aim at establishing an outdoor recreation identity for the Grants area.

C. *Conclusions on Cibola and McKinley County Areas' Adjustment to Uranium Mining Decline*

About 6,400 uranium-related jobs were lost during the 1980s as uranium mining and milling were abandoned. With declines in copper mining and smelting employment, the metal mining job losses in New Mexico totaled close to 10,000. The New Mexico economy was large and diverse enough to digest these jobs losses as it added over a half-million new jobs, over 50 times the number of metal mining jobs lost. As a result, the overall New Mexico economy expanded and diversified significantly so that by the year 2000 metal mining was the source of only one out of every 500 jobs. Over time the unemployment rate dropped to historically very low levels.

Because uranium mining was concentrated in a two rural areas, Cibola and McKinley counties suffered the brunt 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 boom and bust in earnings in mining in the Grants mineral belt, non-mining income and earnings were hardly affected at all. Recall Figures 15a and 15b. The mining sectors were effectively isolated from the rest of the economy during both the boom and bust. After the uranium bust, government, services, and trade sectors continued to expand as did income from retirement and investments. After digesting the loss of the uranium mining jobs, employment, aggregate real personal income, and real per capita incomes in McKinley and Cibola counties rose significantly and unemployment rates declined. Average incomes remained, however, below state levels because of the rural character of the area and the high poverty rates and low incomes associated with the Native American populations that dominate McKinley County and represent a significant part of the Cibola County population.

IV. The Public Costs of Uranium Mining and Milling

If uranium mining and milling involved only the private financial costs that commercial developers had to face, there might not be any controversy about New Mexico accommodating a new uranium mining boom. The risks and costs would be borne by the developers and owners and the rest of the citizenry could trust economic rationality and markets to guide development in an efficient and effective manner.

But uranium mining has most of the same substantial environmental costs that mining in general has and, because of its radioactive character, uranium poses some additional public health concerns. In addition, as discussed above, the uranium industry is

unstable, and prone to booms and busts that disrupt families and communities. Before analyzing the potential economic benefits of a revival of uranium mining in New Mexico, it is important to recall the social and environmental costs that are also associated with that industry.

The costs associated with trying to clean up the persistent radioactive waste and other pollution associated with past uranium mining across the United States provide a stark reminder that uranium mining is not an environmentally benign activity. Up through 1999 the federal government had spent about $1.5 billion to reclaim 24 "inactive" or abandoned uranium mills and tailings that were the legacy of the nation's nuclear weapons program through 1970. As of 2003 that total topped $2 billion.[27] In addition, the U.S. Department of Energy expects to spend nearly $100 million in long-term monitoring and maintenance costs at these sites until 2070 and $50 million in groundwater remediation costs at only three of the 24 sites: Shiprock, New Mexico, and Tuba City and Monument Valley Arizona.[28]

In addition, as of the end of July, 2008, the federal government has paid about $625 million to former uranium workers or their families for the diseases and deaths associated with their exposure to radiation during employment in uranium mines and mills and in hauling uranium ore.[29] These payments have been made under the Radiation Exposure Compensation Act (RECA) which provides compensation awards of up to $100,000 each to people who worked in the uranium industry between 1942 and 1971.[30] Unfortunately, uranium workers employed after 1971 are not eligible for such compensation benefits under that law. That group of past uranium workers not eligible for compensation includes about 7,000 who worked in the New Mexico uranium industry in 1980.[31]

Further, the Navajo Nation has spent more than $23 million to correct safety hazards and perform limited reclamation at nearly one thousand abandoned uranium mines.[32] Navajo Nation officials estimate that at least one-half billion dollars will be needed just to

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[27] U.S. Department of Energy, Energy Information Administration, Uranium Mill Sites Under the UMTRA Program. (http://www.eia.doe.gov/cneaf/nuclear/page/umtra/title1sum.html) .

[28] Robinson, W.P. Uranium Mill Tailings Remediation Performed by the USDOE: An Overview. Prepared for the Citizens' Monitoring and Technical Assessment Fund. Southwest Research and Information Center, May 2004. (http://www.sric.org/U_Mill_Tailing_Remediation_05182004.pdf)

[29] U.S. Department of Justice, Civil Division. Radiation Exposure Compensation System Claims to Date: Summary of Claims Received by 07/28/2008; All Claims. (http://www.usdoj.gov/civil/omp/omi/Tre_SysClaimsToDateSum.pdf)

[30] U.S. Department of Justice. Radiation Exposure Compensation Program. About the Program. (http://www.usdoj.gov/civil/torts/const/reca/about.htm)

[31] New Mexico Energy, Minerals and Natural Resources Department. Chart: New Mexico Uranium Production and Employment, 1980-2005. (http://www.emnrd.state.nm.us/Mmd/MRRS/documents/Uranium.pdf)

[32] Maldonado, Vernon E. Office of Surface Mining Reclamation and Enforcement, Annual Evaluation Report, Evaluation Year 2005 (July 1, 2004 through June 30, 2005) on the Navajo Nation Abandoned Mined Lands Reclamation Program. (http://www.aml.navajo.org/News_Rprts/AML/OSM_AER_Nav2005.pdf)

initiate full reclamation and environmental restoration at more than 500 abandoned uranium mines.[33]

It is almost unavoidable that future mining will release enormous amounts of additional radioactive waste that will require costly remediation efforts. The public, no doubt, will have to shoulder some of that burden too. The remaining uranium ore available to be mined in New Mexico has a relatively low percentage of uranium in it. The New Mexico reserves at or below a future $50-per-pound cost average only 0.167 percent uranium oxide.[34] That is, only one part of the ore in 600 is actually uranium. That means that conventional uranium mining and milling generates massive amounts of ore that must be moved and processed to extract a relatively small amount of uranium, and the rest of the mined material has to be managed and disposed as wastes. Even ignoring the non-uranium ore material that has to be moved to extract the uranium ore, the low-grade ores assure that a large volume of tailings have to be disposed of after the uranium has been extracted.

Since 99.8 percent of the uranium ore extracted in New Mexico is **not** uranium, the volume of tailings is as great as the original volume of ore extracted. Even more problematic, uranium mills only seek to remove one of the radioactive components of the ore, uranium. The milling leaves other radioactive materials as well as a significant amount of uranium in the waste product. About 85 percent of the radioactivity of the ore remains after the uranium has been removed from it.[35] In addition, tailings contain other toxic materials including heavy metals and the chemical solvents used to extract the uranium. That makes disposal of the tailings a serious toxic waste problem. This environmental burden of new mining will add to the legacy of abandoned, toxic and radioactive uranium wastes of the past. Taxpayer funded remediation will likely be necessary for some significant part of this future cleanup too, just as it has for remediation of past mining and milling sites in New Mexico.

The massive volume of toxic waste products associated with conventional uranium mining and milling are not generated by the *in situ* leaching technique, where chemicals are injected directly into the ground to dissolve the uranium. The uranium bearing solution is then pumped to the surface for processing to extract the uranium. While this technique avoids generating massive volumes of mine wastes and mill tailings, the recovery of all of the chemicals and their by-products from the groundwater has proven

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[33]Arthur, George. Testimony before the U.S. House of Representatives, Committee on Oversight and Government Reform, Hearing on the Health and Environmental Impacts of Uranium Contamination on the Navajo Nation, October 23, 2007. (http://oversight.house.gov/documents/20071023103424.pdf)

[34]U.S. Department of Energy, Energy Information Administration, 2004. http://www.eia.doe.gov/cneaf/nuclear/page/reserves/ures.html

[35]National Research Council. *Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings.* Uranium Mill Tailings Study Panel, Board on Radioactive Waste Management, Commission on Physical Sciences, Mathematics and Resources, National Research Council. National Academy Press (Washington, DC), 1986; p. 10. U.S. Environmental Protection Agency. *Final Environmental Impact Statement for Standards for the Control of Byproduct Materials from Uranium Ore Processing (40 CFR 192)*. EPA 520/1-83-008-1, September 1983, Volume I; p. 3-1. Tsivoglou EC, O'Connell RL. *Waste Guide for the Uranium Milling Industry*. U.S. Department of Health, Education and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center (Cincinnati), Technical Report W62-12, 1962; p. 5.

difficult and restoration of groundwater to pre-mining water quality has failed in **all** commercial-scale ISL operations.[36] In addition, a stream of liquid waste is produced when the uranium is extracted from the solution pumped to the surface. This liquid waste is typically disposed of in an evaporation pond (or by land application or deep-well injection), leaving behind waste that has to be carefully handled. As a result, the *in situ* leaching process causes groundwater contamination and the evaporation ponds, or other disposal methods, represent an additional threat of groundwater pollution. Because the vast majority of New Mexicans get their drinking water from groundwater sources, this is a major concern.

The radioactive character of the ore, tailings, and waste has also been a threat to the health of miners. Carelessness, negligence and willful indifference by the uranium mining industry in early mines, mills, and waste dumps led to the illness and death of many miners and family members. That deadly legacy was one of the reasons that the Navajo Nation banned uranium mining and processing on Navajo lands. The primary rationale of the Navajo Nation in banning uranium mining and processing within Navajo Indian Country was to protect its valuable natural and cultural resources from further destruction by the uranium mining and milling industry.[37]

The point here is not that uranium is too dangerous to mine. Mining has been the source of accidents, disease and premature death among miners for centuries. Uranium mining and processing presents its own particular threats that have to be carefully dealt with. The residual environmental and health effects are part of the public costs associated with the uranium industry but which are not included in profit or benefit-cost projections. These costs are difficult to accurately quantify without more accurate public health and epidemiological statistics.

In addition, as discussed above, uranium mining, like metal mining in general, tends to be unstable, fluctuating widely with swings in worldwide uranium prices. New Mexico has been through many such cycles with copper mining over the last two centuries since European-Americans began extracting copper there. New Mexico has also been through one cycle of uranium boom and bust.

In previous studies of the economies of mining towns and regions, I have found that despite the great wealth that is extracted and the relatively high wages paid to workers, mining rarely makes mining towns prosperous places, primarily because of the economic instability associated with mining.[38] In addition, the labor needs of mining

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[36] See the comments of Nuclear Regulatory Commission regional licensing branch chief Bill von Till and Mike Griffin from Uranium One as reported in the Chadron (NE) Record, September 12, 2008. http://www.thechadronnews.com/articles/2008/09/12/chadron/headlines/news905.txt. Also see, J. A. Davis and G.P. Curtis, Consideration of Geochemical Issues in Groundwater Restoration at Uranium In-Situ Leach Mining Facilities, NUREG/CR 6870, January 2007, at 18-23, which explores three examples of "successful" restorations where uranium and radium-226 levels, among other pollutants, were not returned to pre-mining conditions.

[37] 18 N.N.C § 1301.

[38] ***Lost Landscapes and Failed Economies: The Search for a Value of Place***, Island Press, Washington DC, 1995.

operations are continually declining as new labor-saving technologies are deployed. Miners and their families, businesses that serve them, and governments that provide infrastructure and services do not know how long the jobs and payroll will last. As a result, everyone is cautious about making investments in homes, businesses, and public infrastructure because they do not know when the next big layoff will come. As a result, mining, milling, and smelter towns tend to have higher unemployment rates, lower average incomes, and slower rates of growth in jobs and aggregate real income. Mining, in general, does not support sustained local economic vitality. That is the "economic anomaly" of mining.[39]

This too represents a significant social cost that has to be weighed against the economic benefits of mining. When communities become specialized in metal mining, they go through severe cycles of economic expansion followed by economic collapse that severely stresses families and tends to tear the social fabric of communities as workers have to commute out to work or they and their families have to move away.[40] The ongoing decline in labor demand can strand substantial local government infrastructure as well as private commercial infrastructure as the population declines. Mining communities come to be dominated by abandoned businesses and buildings and take on a run-down appearance. The massive damage to the surrounding landscape associated with extracting very low grade ores and disposing of the waste also discourages the in-migration of people and businesses not associated with mining. The result is ongoing local economic decline despite the high wages paid to miners and the huge amounts of wealth extracted.[41]

V. The Potential Economic Impact of Renewed Uranium Mining in New Mexico

A. New Mining in New Mexico is Likely to be Limited

New Mexico experienced a 25-year uranium mining boom from 1955 through 1980. See Figure 2 above. That was followed by a 25-year uranium mining bust that will continue until at least 2013, and perhaps well beyond, despite the increased interest of

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[39] See the author's "The Economic Anomaly of Mining—Great Wealth, High Wages, Declining Communities," in Chapter 3 of ***Mining in New Mexico: The Environment, Water, Economics, and Sustainable Development***, L.Greer Price, et al., editors. New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, 2005. Also the author's ***Lost Landscapes and Failed Economies: The Search for a Value of Place***, 1996, Island Press, Washington, DC.

[40] For a recent review of this literature see William R. Freudenburg and Lisa J. Wilson, 2002. "Mining the Data: Analyzing the Economic Implications of Mining for Nonmetropolitan Regions," ***Sociological Inquiry,*** 72(4):549-75. See, also, Richard S. Krannich and A.E. Luloff, 2992, "Problems of Resource Dependency in U.S. Rural Communities, ***Progress in Rural Policy and Planning*** 1:5-18; Nancy L. Peluso, Craig R. Humphrey, and Louise P. Fortmann, 1994, "The Rock, the Beach, and the Tidal Pool: People and Poverty in Natural Resource-Dependent Areas," ***Society and Natural Resources*** 7(1):23-38; Lisa J. Wilson, 2001, ***Riding the Resource Roller Coaster: A Comparison of Socioeconomic Well-Being in Two Midwestern Metal-Mining Communities***, Ph.D. dissertation, Department of Sociology, University of Wisconsin, Madison, WI.

[41] Power, T. P. Chapters 4 and 5 of ***Lost Landscapes and Failed Economies: The Search for a Value of Place***, Island Press, Washington, D.C., 1996.

mining companies in New Mexico uranium ore since uranium prices began rising in 2004. See Figure 7 above. The delay in substantial development is tied to both the long lead times required for the permitting and building on new mills and mines, and the uncertainty about the future price of uranium dramatized by the dramatic decline in uranium prices between July 2007 and October 2008. See Figures 1 and 7 above. Despite all of the media "buzz" about the impending New Mexico uranium boom, few proposals have moved beyond the conceptual stage.

As discussed above, there are uranium deposits around the world that have higher grades and larger total tonnages available. New Mexico's reserves represent only about two percent of the world reserves. Some of the other 98 percent of the world's uranium reserves are in developing countries where mining costs are likely to be especially low. New Mexico's deposits, in comparison, are now relatively low grade and high cost. This is due in part to the fact that most of the state's high-grade, low-cost deposits were mined out in the original uranium mining boom, during which time the grade of ore being mined in New Mexico fell by 50 percent.[42]

On the other hand, New Mexico's uranium deposits were well explored and studied during the earlier boom. The new mining companies that are now expressing interest in New Mexico's reserves obtained this exploration data and technical analysis at a very low cost from the earlier mining companies, saving the new junior mining companies millions of dollars in exploration and development costs. Moreover, most of these junior companies have little or no experience mining uranium, and none have progressed beyond exploration phases to develop the uranium properties they acquired in recent years.

In addition, while *in situ* leach mining techniques make some of the Grants mineral belt uranium deposits low-cost resources, it is not clear what percentage of those resources has hydro-geological characteristics amenable to ISL mining. For conventional uranium mining, cost factors tend to run the other direction since there no longer are any uranium mills in the area, the old ones having been dismantled and the sites reclaimed. Either new mills will have to be built or the ore will have to be shipped out of state for processing. There are **no** license applications to build a conventional mill in New Mexico.[43] Both these factors would raise the costs associated with conventional uranium mining in New Mexico.

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[42] 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, 2007 annual meeting.

[43] Uranium Resources Inc. (URI) announced its intentions to build a new, conventional uranium mill in Ambrosia Lake in October 2007 at the site of the old Rio Algom mill. In June of 2008 URI announced that it had abandoned its efforts to buy Rio Algom and build a mill at that site because it could not raise the capital necessary. See http://urre.client.shareholder.com/releasedetail.cfm?ReleaseID=318489, Rio Grande Resources Corp., which owns the Mt. Taylor Mine near San Mateo, and Neutron Energy, Inc. have both submitted letters of intent to file license applications for conventional milling facilities with the NRC, but, as of September 2008, no applications have been filed. http://www.nrc.gov/about-nrc/regulatory/adjudicatory/hearing-license-applications.html .

The U.S. Department of Energy estimates of New Mexico's total uranium reserves available at a cost of $50 per pound or less is 341 million pounds.[44] The amount of uranium that is likely to be mined in New Mexico, however, will partly depend on the assumed future uranium price and how much of New Mexico's reserves are open to development.

The 2008 Arrowhead Report discussed above used a base case built around a sustained long run contract uranium price of $90 per pound.[45] At that price it projected 315 million pounds of uranium would be mined in New Mexico over a 30-year period. The low case assumed that instability in uranium prices would lead to 40 percent less uranium being mined, 190 million pounds. On the other hand, if the real value of uranium rose significantly above the $90 base-case price, the Arrowhead Report projected 30 percent more uranium being mined, 400 million pounds.[46]

Thus, the uranium industry projections of as much as 300 to 400 million pounds of New Mexico uranium being mined in the future would require a sustained uranium price of $90 per pound or above. After briefly spiking above this level in mid-2007, uranium prices in 2008 fell to well below this level. In October 2008 uranium prices were at $46 per pound. See Figures 1 and 7 above. Given the substantial world uranium reserves, the still substantial secondary resources from strategic and military stockpiles, and the slow rate at which demand would grow even if the newly planned nuclear generating stations are built, it is unlikely that a uranium price above $90 can be sustained for over three decades.

Substantial amounts of New Mexico's uranium reserves are located on Navajo lands. However, in April of 2005 a new tribal law, the Dine` Natural Resources Protection Act, took effect. The Navajo law bans uranium mining and milling in both the Navajo Nation and in greater Navajo Indian Country. If the Navajo Nation is successful in enforcing this ban, at least 150 million pounds of the 341 million pounds of New Mexico uranium reserves would not be available, leaving less that 200 million pounds of uranium available for development.[47]

Although the Arrowhead Report simply accepted the New Mexico Uranium Producers "wish list" of suggested uranium projects involving 15 new mines and three new uranium mills, only one project, the HRI *in situ* leaching project, has obtained any of its operating permits. The other suggested projects face years of exploration, analysis, and review before they could actually become a reality.

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[44]US Uranium Reserve Estimates by State, 2003. Data released June 2004. http://www.eia.doe.gov/cneaf/nuclear/page/reserves/uresst.html

[45] Op. cit. Peach and Popp, 2008, p. 6.

[46] Ibid. p. 7. Also see Appendix A to the report, "Low and High Impact Scenarios." Actually, the Arrowhead Report assumed a $90 uranium price in all three scenarios when estimating the uranium tax revenues that would be generated. That appears to be an error in the fiscal impact analysis.

[47] This figure is the sum of "measured and indicated" and "historic resource" estimates reported by Uranium Resources, Inc., its subsidiary Hydro Resources, Inc. (HRI), and Strathmore Minerals Corp. for properties they assert a mineral lease or ownership interest in that are located within the boundaries of Navajo Nation chapters.

Finally, given the financial crisis and credit crunch and the related worldwide slow down in economic activity that developed in the second half of 2008, it is going to be very difficult for any of these projects to raise the necessary capital in the face of volatile uranium prices and reduced demand. These financial problems led one mill proposal to be abandoned in June of 2008: Uranium Resources Inc. announced that it had terminated its agreement to purchase Rio Algom Mining and its mill site in the Ambrosia Lake area south of Grants. It cited both the declining price of uranium and the difficulty raising the $127 million to finance the purchase.[48]

If we ignore these serious limitations on renewed uranium mining in New Mexico and assume almost all of the New Mexico uranium reserves, specifically 315 million pounds of uranium, are going to be developed over a thirty-year period, as imagined by the Arrowhead Report, annual production would peak at about 12 million pounds per year with average annual production over that period of 10.5 million pounds. This would be approximately the average production level in New Mexico between 1955 and 1985, the height of the earlier boom. See Figure 2 above.[49] It would also be 5.5 times more than 2007 production in Texas and Colorado, 12 times more than Wyoming production, and 2.5 times more than total American production in 2007.[50] Such a scenario, while possible, is very unlikely for all the reasons discussed above. We will use that level of sustained production, however, to estimate the ***upper limit*** of the economic impacts of renewed uranium mining in New Mexico

B. Employment Levels Associated with Future Uranium Mining

The number of jobs associated with each million pounds of uranium mined and processed will depend on the technology used. Technological changes in mining have dramatically reduced the labor needed to produce any given amount of a mineral. Underground mining with workers using hand tools as they followed veins of high-grade ore gave way to the use of power tools and the introduction of heavy equipment underground in huge cavern-type openings. For many mining operations, underground work was abandoned entirely for open pit mining. In situ leach (ISL) mining eliminates the need to extract waste rock and ore entirely as the minerals are dissolved by injected chemicals and extracted through wells. The mechanical and hydraulic mills for concentrating ores have given way to chemical processes that dissolve the metals from the crushed ores. Similarly, smelters using large quantities of heat to extract metals have been replaced by chemical and electrical processes. Each technological innovation has allowed both the processing of lower grade ores and the reduction of labor requirements per unit of production. That is, labor productivity in uranium mining has steadily and dramatically increased.

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[48] ***New Mexico Business Weekly,*** July 26, 2008, and Uranium Resources, Inc. Second Quarter 2008 Teleconference/Webcast, August 11, 2008.

[49] Figure 2 provides the production data in “short tons” which is the 2,000 pound ton unit commonly used in the United States.

[50] Domestic Uranium Production Report-Annual 2007, release date May 13, 2008, Energy Information Administration, U.S. Department of Energy. Total US production for 2007 of 4.5 million pounds was allocated to the three states based on uranium mining employment in each state.

The U.S. Department of Energy's 1993 annual report on the uranium industry reviewed some of those changes in labor productivity in uranium mining.[51] It pointed out that between 1980 and the early 1990s the output per employee in uranium mining tripled from about 2,600 lbs. to more than 8,000 pounds, primarily due to the introduction of ISL techniques. In 1993 labor productivity using ISL mining was five times that of conventional uranium mining: 20,000 lbs. per worker versus 4,000 pounds per worker. But those 4,000 pounds per worker in conventional uranium mining in 1993 was also 54 percent greater than productivity in conventional mines of the late-70s and early-80s.[52] At the 2005 World Nuclear Association Annual symposium, Phillip Crowson pointed out the dramatic declines in the cost of uranium production after 1980. With inflation removed, cost per pound of uranium produced fell from about $60 to $20 in 2004. He compared the dramatic decline in the costs of uranium production to similar declines in the cost of copper production and warned that "any projections of costs, and by implication prices, that fail to allow for the possibility [of continued increases in mining productivity] will probably overstate future prices, perhaps by a large margin."[53] There is no reason to believe that this ongoing reduction in the labor requirements for uranium mining has come to an end. Over the next several decades new technological developments will reduce the number of workers needed for each million pounds of uranium produced even further.

Uranium production per worker in Wyoming operations was 14,811 pounds in 2006 and over the 1999-2006 period averaged 10,069 pounds.[54] The Cameco Crow Butte uranium operation in Nebraska lists production of 800,000 pounds using 67 workers, including the construction, administration and reclamation staff for an average worker productivity of 11,940 pounds.[55] The Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities—Draft Report estimated typical employment at an ISL operation to be 50 to 80 workers. It also indicated that the annual production capacity of such facilities was in the 1.9 to 5.5 million pound range.[56] This indicates a lower limit on the productivity of 23,750 pounds per worker.

Hydro Resources Inc.'s (HRI) proposed Crownpoint ISL mining project in New Mexico, which is still seeking federal operating permits, estimates that a 2-million-pound-per-year operation would employ 150 people.[57] That indicates labor productivity of 13,300 lbs. per worker, per year. If conventional uranium mining labor productivity was 4,000

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[51] "Uranium in Situ Leach Mining in the United States," William N. Szymanski, in ***Uranium Industry Annual 1993,*** DOE/EIA-0478(93), September 1994.
[52] Ibid. Tables 15, 16 and 21.
[53] "Reflection on the Uranium Market," Phillip Crowson, Figure13, p. 12 and Figure 14, p. 13.
[54] Wyoming Mining Association, www.wma-minelife.com/uranium/umap0002/umap0002.htm .
[55] PowerPoint Presentation for Atomic Safety and Licensing Board tour, 2008. ASLB TOUR 2008rev2.ppt.
[56] NUREG-1910, July 2008, p. 2-4 and 4.5-32
[57] Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico, U.S. Nuclear Regulatory Commission Docket No. 40-8968, February 1997, p. 4-97. Note the decade-old date on this FEIS. The American Mining Association's 2007 comments on NRC's proposed generic EIS for In Situ Uranium Mining drew from the HRI FEIS to indicate the employment associated with *in situ* leaching operations.

lbs per worker in1993, it is reasonable to expect it to be significantly higher in 2013 at which time new conventional uranium mining might be underway in New Mexico. If labor productivity in conventional mining operations is only 40 percent of that associated with *in situ* operations, labor productivity would be 5,300 lbs per worker, a third higher than it was two decades earlier in 1993. That would be a growth rate in labor productivity of 1.5 percent per year in conventional uranium mining, less than half the rate of growth reported for 1980-1993.

The Arrowhead Report used the labor productivity in New Mexico uranium mining and milling processes of the 1970-1980 period to project what labor productivity would be from 2012 through 2042. That is, it assumed that labor productivity would be frozen for most of a century even though uranium production technology had already posted significant improvements in the first part of the 21st century. The Arrowhead Report assumed that uranium production per mine/mill worker would be 3,200 pounds per worker per year.[58] That is only a quarter of the productivity of existing ISL operations and 40 percent below the estimate above of conventional uranium extraction operations.

Since the employment projections associated with any given level of mining are tied to the assumed productivity of the workforce, the Arrowhead Report's use of labor productivity from the 1970s to indicate labor productivity in 2020 or 2030 significantly overstates the actual jobs that will result.

For instance, the HRI Crownpoint ISL project that seeks to extract 2 million pounds per year of uranium, expects to employ 150 workers, but the Arrowhead employment projection would be that the number of direct jobs created would be 625, over four times as many and the company proposing to build the plant actually expects. Clearly this represents a serious, four-fold, exaggeration of the actual expected employment impacts.

At this point it is hard to project what part of future uranium development in New Mexico would be ISL mining and what part would be conventional mining. Because ISL operations necessarily pollute groundwater in ways that cannot be remediated, its use is theoretically restricted to aquifers having specific hydro-geological properties. However, in reality, ISL mines may be permitted in areas where these properties may not exist. Also, some existing underground mines in the Grants mineral belt, as well as uranium deposits close enough to the surface, could be mined through open-pit operations. Others may involve a return to underground mining.

The 1993 estimates of the Energy Information Administration as to the distribution of uranium reserves by type of mining techniques indicated that only 22 percent of the American uranium reserves could be accessed by ISL mining. Underground mines were likely to be used to pursue 52 percent of the reserves and open-pit mines could be used to reach the other 28 percent.[59] Much of New Mexico's uranium is found in sandstone

[58] Op. cit. pp. 86-87.
[59] 1993 Uranium Industry Annual, Table 11.

formations where, depending on the right hydrogeological conditions, ISL might be used. With these data in mind, I assume a third of future uranium extraction in New Mexico will come from ISL mining and the rest from a mix of conventional open pit and underground mining and milling.

With this mix of uranium production methods in New Mexico and labor productivity of 13,333 lbs/worker in ISL and 5,333 lbs/worker in conventional uranium operations, the average worker productivity would be 6,666 lbs per worker. The Department of Energy reports uranium worker productivity across the United States was 6,478 pounds in 2006 and 6,843 pounds per worker in 2005, the most recent years for which there is complete data.[60]

With that mix of extraction technologies used to produce the Arrowhead Report's average of 10.5 million pounds of uranium per year, 1,575 workers would be needed. That represents about one-seventh of one percent of all jobs in New Mexico. Annual job creation in New Mexico between 2000 and 2006 was more than 21,000 jobs. Thus, these potential new uranium mining jobs would represent about 4 weeks of normal job creation across the state. These jobs, however, would be concentrated in Cibola and McKinley Counties where they would represent 4 percent of all jobs there in 2005. Of course, there are not 1,600 unemployed uranium miners in those counties. At the end of 2007 both counties were, according to the official employment data, close to full employment with only 219 workers unemployed in Cibola County and 1,061 unemployed in the larger McKinley County.[61] With close to full employment in these two counties most of these new mining jobs would go to workers who either commute into those counties while living elsewhere or workers who move in from other areas of the state or nation.

The actual number of local people available for general employment, however, may be significantly greater than the official unemployment data suggest. Cibola and McKinley counties are both labeled low-employment counties by the Economic Research Service of the U.S. Department of Agriculture because the percentage of the 21- to 64-year-old population that is employed is less than 65 percent. That would suggest a relatively large pool of discouraged and "unofficially" unemployed workers who might be drawn into the labor force by the presence of attractive jobs. The 2000 Census indicated that the percentage of unemployed people on the Navajo Nation and Reservation Trust lands was three times the unemployment rate for the state as a whole. Given the large Native American populations in both McKinley and Cibola counties, one might expect to find a relatively large number of unemployed and under-employed working-age people within that population despite what the official unemployment statistics suggest. However, whether these Native Americans would, in fact, fill a substantial part of the uranium mining jobs that might be created is an open question.

[60] US Department of Energy, EIA, Domestic Uranium Production Report, May 13, 2008.
[61] New Mexico Department of Workforce Solutions, http://www.dws.state.nm.us/LMI/pdf/ta2007.pdf

HRI says it is committed "to hire from the local Navajo community as much as possible."[62] HRI projects that 100 of the 150 long-term jobs the proposal is projected to create would go to local residents ("community employment"). That analysis and commitment dates back to early 1997 when the official unemployment rate in McKinley County was 10 to 11 percent and there were clearly a significant number of unemployed residents available to fill this relatively modest number of jobs. With the employment situation significantly tightened since then and with a potential 1,575 mining and milling jobs at issue, it is unlikely that local residents would be able to fill most of those jobs.

As discussed above, during the last uranium mining boom, many of the mining and processing jobs in McKinley County went to non-residents who commuted in from outside the county to work. The equivalent of two-thirds of the mining payroll flowed to workers who lived outside the county. See Figure 12 above. In general, the uranium jobs did not go to local residents. This pattern of miners commuting long distances to their jobs is also found across the West and the United States. Given that unemployment rates in the 1970s were two to three times higher than the unemployment rates today, it is likely that this pattern of hiring non-residents for the new mining jobs would be repeated unless there were dramatic changes in policy by governments and mining companies.

Finally, it should be pointed out that between 1985 and 2005 in McKinley and Cibola counties, 17,000 new jobs have been created and filled, expanding the number of jobs by 74 percent. That certainly explains part of the decline in the local unemployment rates. A significant and ongoing out-migration from McKinley County between 1990 and 2006 also tends to bring the labor force into balance with the employment opportunities. About 8,700 residents moved out between 2000 and 2006 and another 5,200 between 1990 and 1999. This out-migration was largely offset by high birth rates so that the natural growth, births minus deaths, exceeded the out-migration and there was net growth in McKinley County population for the 1990-2006 period, although the population declined by 3,000 between 2000 and 2006. Cibola County, on the other hand, had modest net in-migration for the 1990-2006 period.[63]

The employment estimates contained in the Arrowhead Report appear to be dramatically larger than our estimate of 1,575 jobs. For instance, in its summary statement of the estimated impacts of mining and milling uranium lists almost 98,000 direct jobs. When multiplier impacts are included, the total employment impact is almost 250,000 jobs.[64] Given that there are only about 940,000 employed people in New Mexico in 2008, the projected uranium mining appears to have a massive impact on the state economy. But this is because Arrowhead has taken the average number of jobs

[62] FEIS, p. 4-96. It should be noted that whether the HRI project can proceed in light of the 2005 Navajo Nation ban on uranium mining is not clear. In addition, Navajo Nation law requires that jobs be advertised to all Navajo Nation members and that the most qualified be hired. (Navajo Nation Code: 15 N.N.C. 604 B.5-7) This may prohibit giving *local* preference. The "community jobs" could actually go to Navajo people no matter where they lived in the four-state region in which the Navajo Nation is located.
[63] US Bureau of the Census data prepared by the New Mexico Bureau of Business and Economic Research, University of New Mexico, http://www.unm.edu/~bber/demograp2.htm
[64] Op. cit. Table 8.4, p. 87.

and multiplied by the number of years those jobs would last to get the equivalent of worker-years. “Worker-years,” of course, are not “jobs.” Neither “jobs” nor “employment” is usually measured in this way. That approach allows Arrowhead to exaggerate the number of jobs created by a factor of 30. The actual employment level estimated by the Arrowhead Report of the average direct employment from mining and milling an average of 10.5 million pounds a year of uranium is actually “only” 3,280 jobs, just over twice our estimate of 1,575 jobs.

C. Payroll Associated with Uranium Mining Jobs

The HRI Crownpoint ISL proposal FEIS projected annual pay per mining job to be $28,000.[65] That estimate was made in 1997. If that pay level is indexed to the CPI, it would be $36,200 in 2007. The 2002 Economic Census provides data on uranium mining across the United States.[66] The average annual wage was $38,300 in that year. If this wage is also indexed to the CPI, it would be $44,100 in 2007.

In contrast, the average weekly wage for those employed in mining in New Mexico at the end of 2006 was $1,261. That would suggest an annual pay level of $65,600 in mining.[67] Federal data on total earnings and total jobs in New Mexico indicate a much higher average annual pay per mining job in 2006 of about $80,000 although from 1986-2001 the real average annual pay per job in mining in New Mexico was about $60,000.[68] Both of these numbers, however, are dominated by oil and gas extraction and copper mining and are not an appropriate value for uranium mining, especially *in situ* leaching operations. The Arrowhead Report used $83,000 per uranium mining and milling job, a number that was likely tied to the high federal statewide average pay per mining job in oil and gas and copper production.

Finally, the pay levels reported by Cameco’s Crow Butte uranium operation in Nebraska were about $53,000 per worker in 2008, much closer to the $40,000 per job per year figure derived from HRI’s Crowpoint project and economic census data on uranium mining than to the Arrowhead Report assumption.[69] We will use the most recent pay information, the Cameco Crow Butte figure of $53,000 per job per year.

At the employment level derived above and the assumed $53,000 annual pay level, the total payroll would be $83.5 million per year. That would be one-tenth of one percent of total personal income in the state of New Mexico and 4.5 percent of the personal income received by residents of Cibola and McKinley counties. As pointed out above, with close to full employment, this would not necessarily be additional income to existing

[65] Op. Cit. Table 4.27, p. 4-97.
[66] Uranium-Radium-Vanadium Ore Mining: 2002, issued September 2004, Table 2, production, development, and exploration workers and payroll.
[67] New Mexico Department of Workforce Solutions, Quarterly Census of Employment and Wages, fourth quarter, 2006.
[68] Bureau of Economic Analysis, Regional Economic Information System, total earnings in mining divided by total jobs in mining.
[69] Payroll of $3.55 million. Total employees of 67. Cameco Power Point Presentation for the Atomic Safety and Licensing Board Crow Butte tour, 2008.

residents of these two counties but, rather, income that would flow to workers who commute in or who move into these counties from outside the area. Even at the much higher pay levels used by Arrowhead, the uranium mining would not have a major impact on the state or local economy.

D. Multiplier Impacts

Only the jobs and payroll directly associated with new uranium mining are estimated above. As income from mining gets spent, additional jobs will be created in other sectors of the economy. To the extent these jobs are filled by commuting workers, those impacts will be primarily felt outside of McKinley and/or Cibola Counties. A significant part of the expenditures of new workers who move into Cibola and McKinley Counties will also tend to flow out to the larger trade centers, Gallup and Albuquerque, although the Grants urban area could also benefit.

The Arrowhead Report used a statewide labor income multiplier of 1.75 to estimate the indirect and induced impacts of the uranium mining payroll. This means an additional 75 cents of earnings is generated elsewhere in the New Mexico economy for every dollar earned in uranium mining and million. Because pay is significantly higher in mining than average pay in New Mexico, the employment multiplier Arrowhead used is higher, 2.5, meaning that one and a half additional jobs are created by each new job in uranium mining and milling.[70] These are the ***statewide*** impacts, including the impacts felt in the state's largest metropolitan areas. The more rural the area involved, the lower will be the multiplier impacts since those impacts are associated with where the purchases of miners and mining companies actually take place. In addition, it should be kept in mind that since the local counties appear to be near full employment the multiplier jobs and earnings will also tend to go to commuting or in-migrating workers.

E. Tax Revenues Associated with Expanded Uranium Mining

The direct taxes that the state levies on uranium include a severance tax, a natural resources excise tax and a conservation tax on the value of uranium produced. The severance tax is 3.5 percent of 50 percent of the gross value of the uranium produced. The resources excise tax is 0.75 percent of the value of the uranium with some deductions allowed. The conservation tax is levied at the rate of 0.2 percent of the value of the uranium produced. These taxes total to about 2.7 percent of the value of the uranium produced. For a production rate of 10.5 million pounds of uranium a year valued at $50 per pound, these taxes would produce $14.2 million in tax revenues for the state.

The New Mexico state general fund budget signed by the Governor in February 2008 totaled over $6 billion while the total budget was over $13 billion. The $14.2 million in potential uranium tax revenues represents about two-tenths of one percent of total state general fund spending, or $1 out of every $423 dollars.

[70] Op.cit.Tables 8.7 and 8.8, pp. 90-91.

Additionally, two types of property taxes are levied on uranium operations by various branches of local government as well as the state government. The property tax levy is applied to 50 percent of the production value of uranium. The average non-residential property tax rate in 2007 for these two counties was 3.1167 percent. At $50 per pound and 10.5 million pounds of uranium production per year, the tax yield would be $8.2 million.

A property tax is also levied on 33 percent of the value of mining equipment. Hydro Resources Inc. estimated in 1997 that for its proposed Church Rock ISL operation that this would amount to $0.0461 per pound of uranium produced.[71] If the value of the equipment is indexed for inflation, the tax on that property would be $0.0632 per pound of uranium produced in 2008. For a total of 10.5 million pounds per year of production this would come to $664,000 per year. The HRI estimates, however, were for ISL operations. The equipment associated with conventional mining operations would be very different. These HRI estimates lead to total property tax payments (the tax on production and the tax on equipment) from renewed uranium mining totally about $8.9 million per year.

The property tax goes to support a variety of government functions. In 2007 in Cibola and McKinley counties about 40 percent of the property tax levy went to support general county government functions. About 35 percent went to support school districts outside of municipalities. The New Mexico school equalization program, however, operates to make sure that the spending per student for school operations is the same in all school districts regardless of the wealth of the local property tax base. As a result, state government allocations have the effect of neutralizing the impact of local school taxes on the operating budgets of schools. However, through programs that seek to somewhat equalize the funds available for the building, repair, and remodeling of schools, local school districts still rely on local property tax levies to fund such capital investments. In 2007, for instance, 76 to 87 percent of the school district mill levies in the Grants, Gallop, and Zuni School Districts went to fund capital or debt repayment funds.[72]

State support for non-educational local government programs also seek to equalize the resources country governments have at their disposal to a much more limited extent. Finally, about 20 percent of Cibola and McKinley property taxes went to support hospitals and colleges.[73] Table 2 shows the estimated distribution of the projected property tax payments from renewed uranium operations.

[71] Crownpoint EIS, p. 4-102, Table 4.29.
[72] Certificate of Tax Rates, Tax Year 2007, NM Department of Finance and Administration, Budget and Finance Bureau, http://fmb.nmdfa.state.nm.us/content.asp?CustComKey=299892&CategoryKey=299968&pn=Page&DomName=fmb.nmdfa.state.nm.us
[73]. Ibid.

Table 2

Distribtuion of Property Tax Revenues from Expanded Uranium Production	
State	$357,545
County	$3,617,566
School	$3,090,145
Hospital & College	$1,779,472
Total	$8,844,728

The state will also levy taxes on the income earned by the mining companies, the income earned by workers, and the consumption expenditures that workers make. The corporate income tax is quite modest, amounting to the equivalent of 0.3 percent of the economic value created by businesses in New Mexico. If this rate is applied to total impact on business production, including indirect and induced impacts, the corporate profit tax would generate about $4 million per year.[74] The personal income tax on the labor income of uranium workers has averaged about 2 percent and would generate about $2.9 million per year while the gross receipts tax on their consumption expenditures out of that income has averaged about 4.1 percent of personal income and would produce about $6 million per year.[75]

Table 3 summarizes these estimated taxes from a return to high levels of uranium mining and milling in New Mexico.

Table 3

Summary of Estimated Annual Taxes Associated with Renewed Uranium Mining, $millions								
Mining Phase	Direct Taxes Specific to Uranium Mining			Taxes on Businesses Engaged in U Mininig		Taxes on Worker Income Direct, Indirect, Induced		Total
	Severance	Resource Excise	Conservation	Corporate Income	Property Taxes	Personal Income	Gross Receipts	
Construction	$0.0	$0.0	$0.0	$1.9	$0.0	$2.4	$4.8	$9.1
Operation	$9.2	$3.9	$1.1	$4.0	$8.8	$2.9	$6.0	$35.9

Sources: See text.

As pointed out above, the total general fund budget for New Mexico state government for 2008 was about $6 billion while the total budget was over $13 billion. The revenues of all local government units in Cibola and McKinley Counties in 2002 were $275 million.[76] That includes municipal governments and school districts. In 2007 the total

[74] Op. cit, Arrowhead Report, Table 8.11, p. 94.

[75] The tax rates are taken from the Arrowhead Report (pp. 45-47). The average production levels are those used in the Arrowhead Report as is the estimated cost of production. Worker salaries are our estimates as discussed above.

[76] The 2002 Census of Governments is the most recent. The 2007 Census of Governments will not begin releasing 2007 data until the fall of 2008 and later. 2002 Census of Government, Compendium of Government Finances, County Areas, Table 50. County government units include not only the county

budgets for just the county governments of McKinley and Cibola Counties were $75 million although the general fund components of those budgets totaled only $18 million. Clearly the estimated tax revenues from a return to boom times in the uranium industry will not have a major impact on the provision of *overall* state and local government services. On the other hand, different local government functions are financed by different streams of revenues. Many transfers of funds from the state and federal governments to local governments have to go for specific purposes. In addition, local governments may fund certain operations by specific fees, charges, and taxes. Declines or growth in particular revenue streams can have a significant impact on the provision of certain services, at least in the short run before funding mechanisms can be changed.

As mentioned above, school construction and repair is tied to local property tax revenues. The flexibility in county government spending lies primarily in general fund programs which could benefit from local taxes on mining, but the county general funds represent only about a quarter of total county budgets. What is a small increase in revenues relative to the total budget can be a large increase to the general fund budget. Although the overall level of funding available to support state and local government services will not be significantly affected by renewed uranium mining, some important local service could benefit.[77]

The very modest contribution that taxes associated with uranium production will make to state and local government budgets is partly tied to the very modest levels of taxation on uranium production. The combination of the severance, resource excise, and conservation taxes that are directly levied on uranium mining currently sum to about a 2.7 percent tax on the value of uranium mined. At the height of the earlier uranium boom in the 1970s these taxes totaled about 5 percent of the value, almost twice as high. Ordinary businesses serving households in New Mexico pay a gross receipts tax between 5 and 8 percent of the value of what they sell, depending on the city or county in which they operate. Most of that gross receipts tax is passed on to New Mexico households. It is interesting that New Mexico households carry a much larger tax burden than the international mining giants who now control most of the uranium industry.

F. Taxes Are the Price Paid for Services Provided by Governments

Tax revenues from economic activities are often presented as pure financial benefits to state and local governments, a windfall of sorts. In general this is seriously misleading. Taxes are levied to support the public services that households and businesses get from government agencies. Taxes are, in effect, the price paid for those services. All citizens and businesses need roads, police protection, public health and environmental

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government itself but also municipal governments and school districts as well as any special purpose government units.

[77] In the above discussion only county and school funding were analyzed. Municipalities, of course, also levy taxes and provide services. Municipalities, however, are unlikely to benefit directly from uranium mining and milling. Uranium mining and milling are land intensive activities with significant environmental risks. It is unlikely that such an operation would be located within an urban area.

measures, an educated citizenry, social services etc. Expanded business activity and the new residents it brings into an area also bring with it a demand for expanded or new services. The wear and tear on roads increases. The larger the population, the larger must be the law enforcement and justice system and the fire protection infrastructure, particularly given the increased crime and drug use rates commonly associated with boomtown economies. The more families there are, the higher the spending on schools and social support must be. Growing population and expanded industrial activity rarely bring lower taxes. In general, as economic development proceeds, taxes and government spending tend to rise, not fall. That is not surprising. As economic activity expands and the population grows, the aggregate expenditures of the population on private goods and services expand. The same is true of expenditures on public goods and services, that is, taxes. The taxes paid by businesses, workers, and families are not a pure benefit to local and state governments. They are the price paid for the expanded services that those governments will be expected to provide.

The potential $3.6 million in additional county taxes to Cibola and McKinley counties (Table 2) would represent about 5 percent of those counties' combined fiscal year 2007 budgets but 20 percent of the general fund budgets if the increase was used exclusively for those programs. This could provide some fiscal benefit to the county governments as long as the cost of providing services to the new economic activity and population discussed above did not increase county costs by more than 5 percent. It should be kept in mind that most counties, including Cibola and McKinley, do not get most or even the majority of their revenues from the taxes the counties levy. The 2002 Census of Governments indicated that for all of the different units of local government within the county boundaries, only 14 percent of local government revenues in Cibola and McKinley counties came from local taxes, about one out of every seven dollars. Intergovernmental transfers from the state and federal governments were the source of 69 percent of the local government revenues in these two counties.[78]

The county governments themselves rely more heavily on locally raised taxes since the state revenue equalization program for local governments is not as strong as it is for local school districts. In fiscal year 2006 Cibola and McKinley counties spent $61.6 million but collected only $15.7 million of that from taxes they levied. Only about one out of every four dollars spent came from county government tax levies.[79] The bulk of the county government revenues came from revenues transferred to them from the state and federal government, fees that the counties levy, and grants.[80]

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[78] 2002 Census of Government, Government Finances, Individual Governments, Table 13, and Compendium of Government Finances, County Areas, Table 50. www.census.gov/prod/2005pubs/gc02x43.pdf

[79] County Receipts and Disbursements, FY-2006. http://fmb.nmdfa.state.nm.us/content.asp?CustComKey=299892&CategoryKey=299908&pn=Page&DomName=fmb.nmdfa.state.nm.us

[80] The line between a tax and a fee is not always clear. In addition, it is not clear how state-mandated tax levies should be treated. That makes the calculation of local government expenditures funded by local tax effort somewhat arbitrary.

As discussed earlier in this report, uranium mining and milling carries with it significant public costs. New Mexico still faces major legacy costs associated with remediating the public health problems created by past uranium mining. There remain hundreds of millions of dollars worth of damage that still has to be coped with.[81] Nearly 600 abandoned uranium mines have been identified in McKinley, Cibola and Sandoval Counties.[82] The majority of inventoried abandoned uranium mines have no record of any reclamation done or even being required.[83] Large amounts of groundwater contaminated by past mining and milling discharges remain to be cleaned up. The tax revenues we have summarized here appear modest compared to the potential public costs associated with future uranium mining.

G. Summary of Likely Economic Impacts of Renewed Uranium Mining

The above analysis indicates the following economic impacts if almost all of New Mexico's economically feasible uranium reserves (at a sustained $50 per pound price) were mined over the next 30 years. This projection is at the upper end of what is actually likely.

i. About 1,600 uranium mining and milling jobs could be created. This would represent about one-seventh of one percent of total New Mexico employment. Since 2000 the New Mexico economy has created this number of jobs every 4 weeks.

ii. In Cibola and McKinley counties where most of the mining would take place, these jobs would represent an increase in employment of about 4 percent. But both counties are, according to the official unemployment figures, currently at close to full employment with less than 1,100 workers unemployed, and most of them are not miners. If that is the case, most of the new mining jobs would have to be filled by workers commuting in from other areas or new in-migrants, not existing residents.

iii. These new jobs, incomes, and economic activity would have ripple or multiplier impacts that would generate additional jobs. This could increase the impact on personal income by 75 percent and increase the job impacts by 150 percent. Many of those "multiplier" jobs, however, would be located in the larger trade centers including Albuquerque where both businesses and workers make their purchases.

iv. The tax revenues to the state government would total about $36 million per year in a state annual general fund budget of $6 billion and a total budget of $13

[81] Arthur, George. Testimony before the U.S. House of Representatives, Committee on Oversight and Government Reform, Hearing on the Health and Environmental Impacts of Uranium Contamination on the Navajo Nation, October 23, 2007. (http://oversight.house.gov/documents/20071023103424.pdf)
[82] McLemore, V. T., et al. Database of Uranium Mines, Prospects, Occurrences, and Mills in New Mexico. New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology (Socorro), Open-file Report 461, April 3, 2002.
[83] Testimony of Bill Brancard, MMD director, before Legislative Finance Committee, July 10, 2008.

billion.[84] The potential state tax revenues from uranium mining would cover only six-tenths of one percent of a $6 billion state general fund budget.

v. The revenues to the county governments from taxes they levy on the uranium mining would be about $3.6 million per year. This represents about 5 percent of the two county budgets but could be as much as 20 percent of the county general fund budget. The new uranium mining industry, however, would also impose additional costs on the county government. There will be a net fiscal gain to the county governments only if the cost of the additional services is less than the increase in tax revenues.

VI. Looking Beyond the Economic Base View of the Local Economy: Amenity-Supported Local Economic Vitality

The above analysis of the likely economic impacts of a new uranium mining boom took a conventional "economic base" view of the local economy. Within the economic base context, local economic health is determined by the health and profitability of those export-oriented businesses that the local community hosts. In that context, any restrictions that might reduce that profitability can be depicted as threatening local economic health. This way of looking at the economy is the source of the assertion that environmental regulation damages the economy. From this perspective, raising health standards for workers and residents, enforcing water quality standards, or imposing more stringent reclamation requirements on uranium mines can be depicted as threatening local jobs and income. This dichotomy between environmental protection and economic well-being, however, is a false one, largely created by the incomplete nature of the way the economic base approach encourages us to think about the local economy.

Discussions of the Grants mineral belt economies are almost exclusively carried out in the context of the economic base view. In that view, businesses are assumed to locate in a community because of certain site-specific economic resources such as uranium ore. These business firms create jobs to which the workforce responds. Workers and their families move to where the jobs happen to be located. The distribution of these export oriented natural resource firms explains why people live where they do. Or so this incomplete economic base view of the local economy assumes.

To many this is just hard-nosed economic realism. "That's the way the economy is."

However, the economic base approach implicitly makes two assumptions that, when stated, appear very questionable. The first implied assumption is that people do not care where they live. They simply move to where the economy demands. The second implied assumption is that business firms also do not care about where workers live or would like to live or where the markets for those business' products are located. The

[84] This assumes that the property taxes shown in Table 2 go exclusively to local governments and that gross receipts taxes and the direct taxes on uranium mining go exclusively to the state government. Neither of these is strictly true since the state and local governments share some of these tax revenues.

location of the population determines both of these, but firms are assumed to ignore both and choose their location on some other basis. Neither of these assumptions can be defended on either theoretical or factual grounds. When these indefensible assumptions are discarded, residential location choice becomes an important economic force in determining the location of economic activity and seriously undermines the reliability of the economic base view of the local economy.

During the second half of the twentieth century, changes in the economy have made residential location choices increasingly important in the determination of the location of economic activity. These changes have made both people and businesses more mobile. The following changes have contributed to the increased importance of residential location choice:

i. Improvements in transportation and communications that have drastically reduced the costs associated with geographic distance from economic centers. These changes include improved highway systems, the extension of regular airline service to small cities, the development of modern telecommunications networks and technology, the development of national and international television networks that reach the most isolated locations, and the emergence of competing next-day courier service. These changes significantly reduce isolation from the national economy and culture associated with locations far removed from the nation's largest metropolitan areas.

ii. Changes in what the economy produces have also had an important impact on the location of economic activity. With the shift from the dominance of extractive and heavy industry to light manufacturing and services, the relative importance of transportation costs has declined as the value to weight ratio has risen dramatically. Transportation costs no longer tie economic activity as tightly to particular locations.[85]

As a result of these changes and the relative mobility of economic activity, it is less costly for citizens to act on their preferences for certain types of living environments. Similarly, it has made it more feasible for economic activity to follow the population as it makes residential location decisions. The result is that economic activity increasingly follows people rather than people following businesses. Consider the shift of economic activity from center cities to suburbs: first people fled those centers of employment and commercial activity and commuted back for work and shopping. Later the manufacturing base followed the population to the suburbs, as did the shopping centers. Similar things can be said about the move to the Sunbelt or the current resettlement of the Mountain West.

[85] Mills, Edwin S., and Gary Chodes. 1988. "Non Extractive Employment Outside Metropolitan Areas" in ***National Rural Studies Committee: A Proceedings***. Hood River, Oregon. May 24-25, 1988. Corvallis, OR: Western Rural Development Center, Oregon State University. Edited by Emery Castle and Barbara Baldwin, pp. 29-36. Mills, Edwin S. 1987. The Determinants of Small Area Growth. Lecture Series 1. Corvallis, OR: Oregon State University, Graduate Faculty of Economics.

An analysis of population growth in non-metropolitan counties during the 1990s clearly indicates the role that residential choice has been playing in determining local economic vitality. If non-metropolitan counties are sorted on the basis of the various economic categories the Economic Research Service of the U.S. Department of Agriculture has developed, the importance of local attractiveness is clear. The fastest growing non-metro counties are retirement counties – including Cibola and Valencia Counties -- counties dominated by the presence of federal lands and recreation opportunities. See Table 4, below.[86] Counties with traditional export-oriented economic bases (manufacturing, farming, and mining) had the greatest difficulty retaining their existing populations and attracting new residents.

But Cibola and McKinley Counties were relatively successful in weathering the collapse of uranium mining and processing. After a brief adjustment period, aggregate real income, jobs, and real per capita income returned to a growth path. See Figure 20. Retirement and investment income, services and retail trade as well as the government sectors expanded despite the collapse of the previous economic base built around uranium mining. See Figure 21. Cibola and Valencia Counties have been classified as "retirement destination" counties by the USDA Economic Research Service because of the growth in the over-65 population due to in-migration. Both McKinley and Cibola Counties are also classified as "government" counties because of the role played by government employment in their economies. The growth of the prison industry in the Grants area contributed to this.

Table 4

Population Change in Non-Metro Counties by Type of County, 1990-2000

County Type	Population Change	Net Migration
Retirement	28.4%	25.9%
Federal Lands	22.3%	16.4%
Recreation	20.2%	16.9%
Commuting	15.2%	12.0%
Services	14.6%	11.7%
Government	11.5%	5.2%
Non-Specialized	10.9%	8.4%
Total Non-Metro	10.3%	6.9%
Manufacturing	9.5%	6.1%
Poverty	9.1%	4.4%
Transfer Payments	8.5%	6.5%
Farming	6.6%	3.9%
Mining	2.3%	-1.5%

[86] Table 3 in "Nonmetro Recreation Counties: Their Identification and Rapid Growth," Kenneth M. Johnson and Clavin L. Beale, ***Rural America*** 17(4):12-19, 2002.

Figure 20: Indices of Economic Vitality in Cibola and McKinley Counties

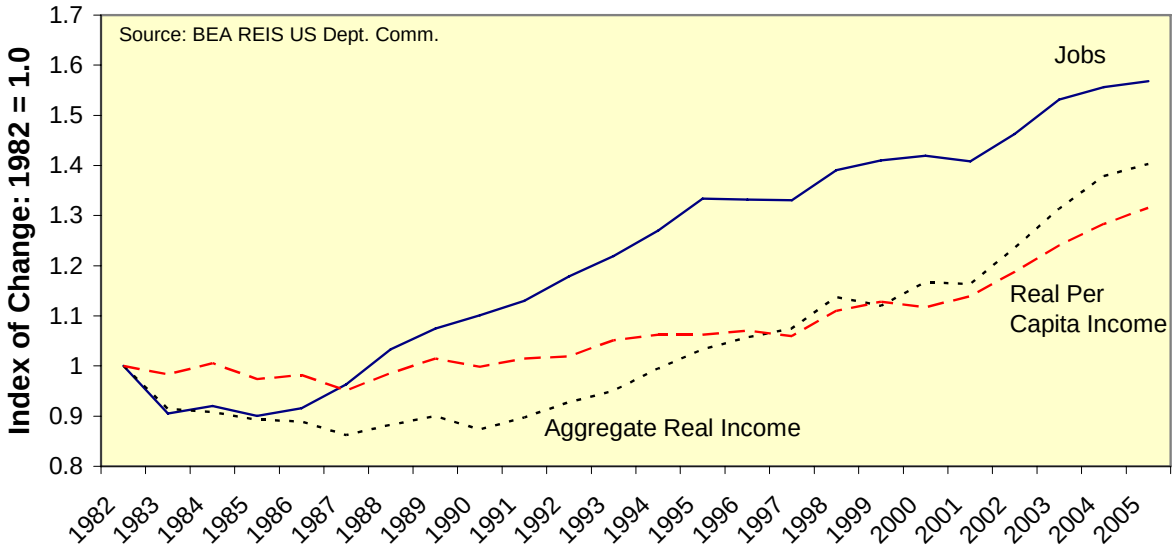
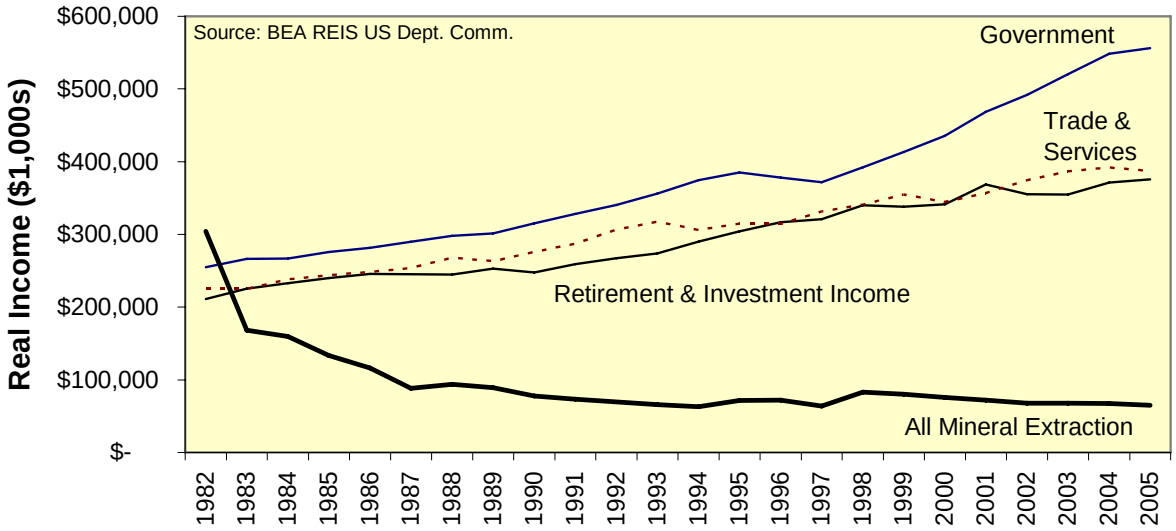


Figure 21: Sources of Economic Vitality in Cibola and McKinley Counties



A narrow economic base view of the local economy focused primarily on natural resource development for export as the primary source of economic vitality would have projected an economic collapse across the entire economy in these two counties as the uranium industry all but disappeared. But that is not what happened. Clearly there were other sources of economic vitality in these two counties other than uranium mining. These economies were not ***just*** mining economies. The focus on natural resource

exports provided a misleading picture of the full range of economic forces supporting the local economies.

Since the mid-1950s economists have emphasized the importance of residential location decisions as a powerful economic force. They focused on the role of local environmental "amenities" such as climate and natural landscapes in the settlement of the desert Southwest (including New Mexico, Arizona, and Southern California), Florida, and the Pacific Northwest.[87] Tiebout (1955) underlined the fact that people "shop around" for the social amenities produced by different levels of local government taxation and different public spending patterns.[88] Borts and Stein (1964) argued that in a mobile, open economy, it would be an area's ability to attract and hold a labor force without bidding labor costs up that would determine the geographic distribution of economic activity.[89] These economic forces tied to local amenities continue to operate in important ways today, helping to explain the above average economic performances of the Mountain West including New Mexico, the Southeast, and the Pacific Northwest over the last decade.[90]

Conventional regional economic analysis now regularly takes into account the role of social and natural amenities in explaining migration patterns and regional development patterns. The US Department of Agriculture, for instance, which long has used farm, manufacturing, and mining to classify the major economic characteristic of non-metropolitan counties in harmony with the simple economic-base approach, has expanded its economic classification to include "amenity" counties. This became necessary in the 1980s when a group of non-metropolitan counties showed ongoing growth despite the economic difficulties most non-metropolitan counties were having. The common denominator in these counties was their attractive landscapes and climatic features that attracted recreationists, retirees, and other new residents. This impact of amenities has accelerated in the 1990s.[91] Similarly, most migration modeling now takes

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[87] Ullman, Edward, 1954, "Amenities As a Factor in Regional Growth, ***Geographic Review***, 44(1):119-132.

[88] Tiebout, Charles, 1956, "A Pure Theory of Local Expenditures, ***Journal of Political Economy***, 64(2):160-164.

[89] Borts, G.H., and J.L. Stein, 1964, ***Economic Growth in a Free Market***, New York: Columbia University Press

[90] Thomas M. Power and Richard Barrett, ***Post Cowboy Economics: Pay and Prosperity in the New American*** West, Island Press, Spring 2000; Power, Thomas M., 1995, editor, "Economic Well-Being and Environmental Protection in the Pacific Northwest: A Consensus Report by Pacific Northwest Economists", Department of Economics, University of Montana, Missoula, MT, December.

[91] U.S. Department of Agriculture (USDA), 1996, Economic Research Service, ***Rural Conditions and Trends***, 7(3):40-44, p. 9. See also Deavers, K., 1989, "The Reversal of the Rural Renaissance", ***Entrepreneurial Economy Review,*** 3-5; Beale, C.L. and G.V. Fuguitt, 1990, Decade of Pessimistic Nonmetro Population Trends Ends on Optimistic Note, ***Rural Development Perspectives***, 6(3):14-18; Peggy J. Cook and Karen L. Mizer, ***The Revised ERS County Typology: An Overview,*** Rural Development Research Report Number 89, Economic Research Service, USDA, 1994; Johnson, Kenneth M., and Calvin L. Beale, "Nonmetropolitan Recreational Counties: Identification and Fiscal Concerns", ***Demographic Change and Fiscal Stress Project*****,** Loyola University, Chicago, January, 1995.

into account the role of local amenities along with employment and income opportunities and cost of living.[92]

Of course, most areas are not "amenity" magnets that draw national attention. That, however, does not mean that the attractiveness of a particular area to current and potential residents is unimportant. Most small towns and rural areas in the West, for instance, have gained population and the new economic activity that supports it during the 1990s and 2000s, not just those with destination resorts or those that have attracted high tech firms.[93] The natural, cultural, environmental and social characteristics of a local area that allow it to attract and hold people are an important part of the area's economic base. If this is not recognized, that part of the economic base may be irreversibly damaged.

When we recognize the importance of social and natural amenities to local economic vitality, a quite different picture of the forces driving the local economy emerge. The ability of an area to attract and hold residents is central to its economic vitality. In that context, those locally specific qualities that make a particular area an attractive place to live, work, and do business are not just of aesthetic interest, they are part of the local area's economic base. High quality living environments attract and hold people and businesses. That in turn triggers a series of dynamic changes that support ongoing local economic vitality. The quality of the social and natural environments has profound economic implications.

The local economic development case for protecting natural landscapes can be summarized very directly: People care where they live. They care about the qualities of the natural and social environments that make up their living environment, and they act on those preferences. They are willing to make sacrifices to obtain access to these natural amenities. High quality natural environments draw people and businesses to areas even when economic opportunities are otherwise quite limited. As a result, economic activity shifts towards those preferred living environments.

Because this aspect of community economic development shifts the emphasis away from exclusive focus upon natural resource extraction industries, it might be interpreted as suggesting that natural resources do not matter as much to these communities any longer. But the primary message is quite different. It is that the role of natural resources in the local economy is *not* diminishing but *changing* from extraction and export to non-consumptive and environmental. Communities' economic health continues to depend on the surrounding natural landscapes, but in a fundamentally different way. Our natural landscapes are no longer primarily warehouses from which to extract commercially valuable resources or just a playground where commercial

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[92] Greenwood, Michael J., G.L. Hunt, D.S. Rickman, and G.I. Treyz, 1991,"Migration, Regional Equilibrium, and the Estimation of Compensating Differentials," ***Journal of Regional Science***, 26(2):223-234. Berger, M.C. and G. C. Blomquist, 1992, "Mobility and Destination in Migration Decisions: The Roles of Earnings, Quality of Life, and Housing Prices," ***Journal of Housing Economics*** 2: 37-59.

[93] See the special issue of ***Rural Development Perspectives*** on the rural West, 14(2), August 1999, USDA, Economic Research Service.

companies can entertain temporary visitors. They are now the source of increasingly valuable environmental services, including: clean water and air, cultural and historical preservation, recreational opportunities, wildlife, scenic beauty, biodiversity, and environmental stabilization. Those environmental services provided by protected landscapes make the communities embedded in them attractive places to live, work, and do business. This supports and enhances local economic vitality and well-being over the long term.

Extractive industry, including metal mining, *has* generated ghost towns in the past. When it was *only* the employment opportunities in mining or logging or agriculture that drew people to an area, the ultimate decline in employment opportunities in those sectors meant there was nothing else to keep people in the area. As a result, those communities lost population or were abandoned. New Mexico, like a good deal of the Mountain West, has its mining ghost towns, but Gallup and Grants are not among them despite the past collapse of the uranium industry. The northern tier of the nation also has many examples of logging ghost towns. The Great Plains has hundreds of agricultural ghost towns. High quality living environments, on the other hand, prevent ghost towns by attracting and keeping economic activity. Because of this, it is vitally important from an economic viewpoint to treat environmental regulation as part of a region's or state's economic development strategy rather than allowing economic development strategy to constantly undermine efforts to protect the social and natural environments. An economic development policy focused on reviving the industries that were important sources of jobs and income in the past by sacrificing additional elements of the natural environment, in the present and future, may actually be ***undermining*** the economic future of a region.

However, as discussed above, advances in transportation and communications and changes in what it is that the economy produces have dramatically reduced the costs associated with geographic isolation. As economic activity has become relatively more mobile a different set of local characteristics, other than the presence of extractable natural resources, has become important in determining the location of economic activity: the quality of the local labor force, the quality of the public infrastructure, including schools, parks, and libraries, and the quality of the social and natural environments. In the jargon of economics these factors can be labeled human, social, and natural capital. Those areas across the nation that have been successful at attracting significant amounts of new economic activity over the last decade were not those that continued to specialize in natural resource extraction. In fact, those areas lagged behind in all community economic categories. See Table 4, above. It has been areas that are perceived to have the human, public, and environmental resources that made them attractive residential locations that have prospered.[94]

[94] For supporting evidence from the Western states see: "Amenities Increasingly Draw People to the Rural West," Gundars Rudzitis, and "Jobs Follow People in the Rural Rocky Mountain West," Alexander C. Vias, ***Rural Development Perspectives,*** 14(2), August 1999***.*** For the Great Plains see "Net Migration in the Great Plains Increasingly Linked to Natural Amenities and Suburbanization," John B. Cromartie, ***Rural Development Perspectives***, 13(1), June 1998. For the South see "Migrants in the Rural South Choose Urban and Natural Amenities, John B. Cromartie, ***Rural Development Perspectives***, 14(4), February 2001.

High quality natural amenities contribute in a dynamic way to the location of economic activity. Areas that have been able to attract and retain a high quality labor force are attractive because of those human resources. Areas that do not have that labor force but have attractive characteristics that allow the recruitment of the necessary skilled workforce without paying inflated wages also have an advantage.

The ongoing growth in employment, real income, and population despite the disappearance of uranium mining and the loss of 90 percent of metal mining jobs overall in New Mexico makes clear that the Grants area and New Mexico can compete as the location of new economic activity. New Mexico's presentation of itself to the rest of the nation and the world as the "land of enchantment" rather than the land of uranium and copper production or other industrial activities clearly indicates that New Mexico understands the importance of natural and cultural amenities.

VII. The Costs and Benefits of a New Uranium Boom Should be Weighed Before Uncritically Embracing It

As discussed above, the State of New Mexico and Cibola and McKinley counties, after suffering through the expected dislocations and adjustments, successfully "digested" the uranium "bust" of the 1980s and moved on to diversify their economies and expand the range of economic opportunity. The near disappearance of uranium mining and milling did not create ghost towns or permanently disable the state or local economies. Unemployment rates are low, real incomes are rising, jobs are being created. In that sense, the New Mexico and the Grants area local economies are not intractably depressed, needing to be rescued by another dramatic commodity boom. Citizens can afford to be critical, discriminating choosers who weigh the benefits and costs of a renewed uranium boom.

Also as discussed above, the economic impacts of a renewed uranium boom would be quite modest at best. At the state level the economic benefits would be almost imperceptible. At the local level it would likely make a difference but would not in any sense transform the local economies. Uranium mining, like all the mining sectors, has continued to deploy technological innovations that have steadily reduced the labor demands per unit of production. As a result, the number of jobs and the payroll associated with a renewed uranium industry would be quite modest.

The social and environmental costs associated with uranium mining and processing remain significant. New Mexico has had intimate experience with the health consequences of past uranium mining practices. New Mexico also faces an enormous legacy associated with abandoned mines and very large mines that ultimately will be closed and have to be reclaimed as best they can be. New Mexico and its mining communities have repeatedly suffered through the booms and busts associated with metal mining and its instability due to the volatility of worldwide metal prices.

Some of the environmental costs associated with uranium and other metal mining are nearly permanent in character. Large open pits cannot be realistically reclaimed. Some of the chemical and biological processes triggered when millions of tons of metal ore are brought to the surface and exposed to air and water or where air and water are brought to underground ore deposits cannot be easily stopped. They can only be controlled by perpetual treatment. When the chemical processes used in ISL mining processes escape their intended geological formations or the hydrology turns out to be more complicated than expected, it is nearly impossible to contain them and return the groundwater to its previous condition. In general, American ISL uranium mining operations have not been able to return groundwater to its pre-mining condition. Uranium mining brings both short- and long-lived radioactive material to the surface, increasing human exposures.

The challenge represented by uranium mining, like all metal mining, is that it is a landscape-intensive activity that almost always has had significant negative impacts on the natural environment. That means that it has the potential to damage one part of the local economic base, environmental quality, while developing another, the mineral deposit. To the extent that the environmental damage could be significant and near permanent while the mineral development, in contrast, is a relatively temporary “boom,” significant public economic policy issues are raised: Does New Mexico and the Grants area want to once again ride the metal mining roller coaster? Is there a net gain or loss to the local economic base as a result of developing the uranium deposits?

The environmental record of uranium mining, including that of many mines closed at the end of the last uranium boom, clearly indicates that these questions have to be explored carefully and critically. This is not “merely” a matter of aesthetics or an impractical effort to preserve “prettiness.” It goes to the heart of the future economic vitality and sustainability of the Grants area and New Mexico economies. That is the reason that a rational review and careful public regulation of uranium mining must be an important part of New Mexico’s economic development policy as well as its environmental policy.

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