Cost Analysis of Uranium Mining in the Grants Mining District, New Mexico, 1955-1989

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INTRODUCTION

New Mexico was the dominant producer of uranium in the U.S. for almost three decades starting in the mid-1950's and currently has the 2nd highest reserves in the U.S. From 1951-1980, the Grants uranium district in northwestern New Mexico yielded more uranium than any other mining district in the United States, amounting to just under 350 million pounds of U3O8 or 37.5% of total U.S. production over the 1947-2002 period (McLemore, 2007).

While there are several studies looking at the economic benefits of past and proposed uranium mining in New Mexico, no study to-date has compiled the economic costs of past uranium production in the Grants district. The legacy of uranium mining in New Mexico is still felt today with active mine and mill reclamation at dozens of sites across the state. In addition, past exposures to radon gas in underground uranium mines continues to take its toll on former miners in terms of lung cancer and debilitating respiratory illnesses (Boice et al., 2008). We are the first to provide cost estimates of past, on-going, and projected reclamation and remediation costs as well as estimates of the costs associated with unintended premature deaths for miners in the Grants district over 1955-1989 (all mining ceased in 1989).

We compile a present value estimate of the overall costs borne by the mining companies, Tribal Nations, the state of New Mexico and the Federal government.

OBJECTIVES

- Estimate present value mill & mine reclamation and remediation costs; 1981-2070
- Calculate person-years of life lost (PYLL) among underground uranium miners due to radon exposure; 1955-1989
- Using PYLL results, estimate for aggregate Grants miners:
  - Indirect costs to society of premature loss of life (value of lost utility and net savings at time t)
  - Direct medical costs of lung cancer diagnosis and treatment
- Perform a sensitivity analysis to develop a lower-bound and an upper-bound estimate of present value costs

RESULTS

Table 1: Number of excess lung cancer deaths among Grants miners

<table>
<thead>
<tr>
<th></th>
<th>Lower-bound</th>
<th>Benchmark</th>
<th>Upper-bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excess Lung Cancer</td>
<td>464.04</td>
<td>687.12</td>
<td>933.85</td>
</tr>
<tr>
<td>Deaths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% of unique miners</td>
<td>1.42%</td>
<td>1.79%</td>
<td>2.02%</td>
</tr>
</tbody>
</table>

Table 2: Present value reclamation & remediation costs of Grants mining (2012)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Lower-bound</th>
<th>Benchmark</th>
<th>Upper-bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reclamation &amp; Remediation Costs</td>
<td>$374 million</td>
<td>$417 million</td>
<td>$473 million</td>
</tr>
<tr>
<td>$/lb. U3O8&lt;sup&gt;1&lt;/sup&gt;</td>
<td>$1.13</td>
<td>$1.26</td>
<td>$1.43</td>
</tr>
</tbody>
</table>

Table 3: Present value human health costs of Grants uranium mining (2012)

<table>
<thead>
<tr>
<th>Health Costs</th>
<th>Lower-bound</th>
<th>Benchmark</th>
<th>Upper-bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct (Medical Costs)</td>
<td>$101 million</td>
<td>$156 million</td>
<td>$212 million</td>
</tr>
<tr>
<td>Indirect (Value of PYLL)</td>
<td>$638 million</td>
<td>$2.56 billion</td>
<td>$6.15 billion</td>
</tr>
<tr>
<td>TOTAL Direct + Indirect</td>
<td>$739 million</td>
<td>$2.72 billion</td>
<td>$6.36 billion</td>
</tr>
<tr>
<td>$/lb. U3O8&lt;sup&gt;1&lt;/sup&gt;</td>
<td>$2.24</td>
<td>$6.23</td>
<td>$19.26</td>
</tr>
</tbody>
</table>

Combined environmental and human health cost estimates range from $1.1 billion to $6.8 billion with a point-estimate of $3.1 billion (2012).

DATA & METHODS


METHODS: Reclamation & remediation costs are converted to present value using the BLS CPI (U.S. city average) and a 7% discount rate (following OMB Circular A-94). When uncertainties exist in the cost data, median values are used for benchmark estimates. Long-term surveillance costs are included when available.

The "Number of Excess Lung Cancer Deaths" are calculated as:

\[
\text{Excess Lung Cancer Deaths} = (\#\text{Unique Miners}) \times \left( \frac{1}{10} \right)
\]


The "Value of PYLL" is calculated as:

\[
\text{Value of PYLL} = (#\text{Excess Deaths} \times VLY) \times [\text{DeathAge} − E(\text{DeathAge})]
\]

Expected age of death based on life table data for a person of given age, sex and race. This is done for the median Grants district uranium miner using CDC lifetables and previous cohort studies.

CONCLUSIONS

- Reclamation & remediation costs are likely lower-bounds on actual costs due to incomplete data and uncertainty on future costs
- Most site reclamation will be complete by 2022. Future clean-up costs will be due to remediation and site surveillance by DOE
- Indirect human health costs provide a measure of the negative externality to society created by uranium mining; $638 million to $6.15 billion
- Wide ranges in health costs driven by VLY ($100,000-$300,000) and number of excess lung cancer deaths

REFERENCES


ACKNOWLEDGEMENTS

We thank Dr. Jonathan Samet and Dr. John Boice for pointing-out to us various data sources on excess lung cancer deaths among Grants uranium miners.

This work was supported by a Doctoral Fellowship from the Robert Wood Johnson Center for Health Policy at UNM, 2011-2013.