Atlantic Alliance Meeting
September 22-23, 2005
Orlando, Florida

State of Mining Engineering Programs and Recruitment in the U.S.

and

Training New Miners
State of Mining Engineering Programs in the U.S.
Labor shortage forces coal companies to woo miners from rivals

Situation will worsen with next wave of retirements

BY CHARLES BUCKMAN
The Associated Press

PITTSBURGH - While much of the country struggles with a difficult job market, one commodity is in a continued expansion for workers... Read more.

Elko Daily Free Press

ELKO DAILY FREE PRESS

Thursday, September 23, 2004

Worker shortage boosts miner pay

By ADELLA HARDING, Staff Writer

INCLINE VILLAGE - Nevada Mining Association's new report on the mining industry shows that the average annual pay in the metal mining sector in 2003 was $67,795, an increase due in part to a shortage of job applicants.
School crisis an acute problem

The outlook for coal may be rosy, but the industry forecast for qualified mining professionals coming into the field is anything but. American Longwall Magazine asked Dr. B Larry Crowder, chair of the number of mining programs has created a severe shortage of workers. The problem is they have a huge gap, not only in experience but in familiarity with the kinds of situations you can get into that can be acute.

International Longwall News + Growth bottleneck

Growth bottleneck

Wednesday, December 29, 2004

AUSTRALIAN mining is booming, but will a lack of professionals restrict industry growth

Andrew Okely*

The Australian mining industry is in the midst of a significant period of capital investment and growth. Many believe the apparent increase in production in China will ensure this growth continues for some years to come. With iron ore, coal, gold, copper and nickel prices all strong, there are many greenfield and brownfield projects in the pipeline. All of this has highlighted the growing problem of a lack of professionally trained engineers and scientists in the industry.
Factors for Closure or Decline
(12 accredited programs left in U.S.)

- Student enrollment
- Lack of cogent public message of value
- University economics
- Dearth of federal research support
Student Enrollment - It is weak nationwide!
Testimony

Oversight Hearing on the Aging of the Energy and Minerals Workforce;
A Crisis in the Making?

SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
COMMITTEE ON ENERGY AND COMMERCE
UNITED STATES HOUSE OF REPRESENTATIVES
WASHINGTON, DC

July 8, 2004

Dr. Mary M. Poulton
Department Head and Professor
Department of Mining and Geological Engineering
The University of Arizona
Tucson, AZ

U.S. Mining Engineering Programs Terminated since 1985

- Univ. California-Berkeley
- Univ. of Illinois
- Ohio State Univ.
- Univ. of Minnesota
- Univ. of Alabama
- Univ. of Idaho
- Columbia Univ.
- Univ. of Pittsburgh
- Texas A&M Univ.
- Univ. of Washington
- Univ. of Wisconsin (2)
- Univ. of Wyoming
- Michigan Tech Univ.
# U.S. Mining Engineering Program Enrollments


| University       | Last Report Period | Enrollments Undergraduate | Graduate | Total | 2002-03 Number of Graduates
<table>
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<td>25</td>
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<td>31</td>
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<td>Michigan Tech**</td>
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<td>36</td>
<td>10</td>
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<td>31</td>
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<td>2003-2004</td>
<td>22</td>
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<td>48</td>
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<td>Virginia Tech*</td>
<td>2003-2004</td>
<td>115</td>
<td>21</td>
<td>136</td>
<td>20</td>
</tr>
<tr>
<td>West Virginia</td>
<td>2003-2004</td>
<td>33</td>
<td>25</td>
<td>58</td>
<td>6</td>
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<tr>
<td><strong>Total</strong></td>
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<td><strong>603</strong></td>
<td><strong>195</strong></td>
<td><strong>798</strong></td>
<td><strong>100</strong></td>
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<td><strong>Average</strong></td>
<td></td>
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<td><strong>16.25</strong></td>
<td></td>
<td><strong>7.14</strong></td>
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* Degrees offered in Mining and Minerals Engineering
** Program eliminated
# Program reformed into Mining Engineering and Management

Only 86 in 2003-04!!!!!
Into the far reaches of Alaska

by Claire Faucett (denbo@umr.edu)

This past summer, Steve Dismuke became the first graduate from UMR’s online master’s degree program in mining engineering. Even though the program is online, Dismuke did most of his coursework from CDs UMR mailed to him. The technology many of us take for granted hadn’t reached northwestern Alaska yet.

grant hadn’t reached northwestern Alaska yet, he explains.

“I had been a mine superintendent for the last 12 years and had gotten away from the engineering work,” he says. “I was concerned that one day I may have to rely on those engineering skills again, especially the way the job market changes. I thought it would be a good idea for me to sharpen my skills and do a little bit of self-improvement.”

As it turns out, Dismuke was right. He is now the project engineer for Vulcan Materials Co., a construction aggregate company in Bartlett, Ill. “I’m back in an engineering role and am using things I learned in school previously, but I picked up quite a few more things from my master’s work,” he says. “Classroom work is great. You get the theory, but a lot of times until you see it in action, it can be difficult to comprehend.”
Public Message
and
What to do
Mining's image — what does the public really think?

Nancy Bingham

The mining industry's image is molded by what the public knows, or thinks it knows about mining. As Caterpillar prepared for the production of its educational video, Common Ground, the public's perceptions about mining needed to be established. Before we could educate people about mining, we had to find out what they already thought.

As those perceptions were analyzed, we were able to narrow the video's focus to relevant, realistic approaches. We found out what people did not know about mining. And, most importantly, facts they should know were singled out — facts that could create more favorable attitudes. This research was instrumental in the final direction of the Common Ground project.

What the public believes

As these perceptions about mining were researched, it was found that the beliefs of the general public are dominated by four concepts. Quotations from interviewees are included with the discussion of each of these concepts. Figure 1 shows an overview of people's beliefs before education.

- The public believes mining harms the environment.
- The public believes that mining has

Mine reclamation projects occur simultaneously with mine production. Pictured is a Caterpillar truck operating on a haul road adjacent to a reclaimed area.

ined. Animals losing their homes.

- "People are most likely to associate surface mining with all forms of above-ground mining. Virtually everyone is convinced that surface mining creates wasteland."
- "Strip mining is certainly the most visible. Miles and miles of wasteland."

open pit with an expression of concern for the land. People think that when a mining company is finished with the mine, they simply abandon the exposed pit.

- "That was ugly. To me, it is like strip mining. Nothing is ever going to
The public believes mining harms people in nearby communities

The images are of dark, dingy mining towns, noise and, again, water and air pollution. This creates a general belief that mining is harmful to people in nearby communities. If a mine opened within 8 km (5 miles) of their homes, most people would expect problems with health, depreciation of land values, contaminated water, dirt in the air, noise and vibration. There is also a general concern for others and about what might happen if a mine located near them. This, too, contributes to a negative attitude about mining.

- “I just think there would be some long-term health problems. Even short-term type health problems.”
- “I would worry about the hazards of mining, explosions.”
- “Would the water become contaminated?”

The public believes mining exploits workers

Particularly among high school graduates, there is a belief that miners are exploited by big business. Since high school graduates are often employed in blue-collar occupations and are constantly feel exploited, they identify to some extent with mine workers. This is not as prevalent with college graduates, but they, too, think that mining is unsafe for workers. They believe that there is potential for injury and long-term damage to workers’ health. The result is another reason that people have a negative attitude about mining.

- “Low pay. Hard work.”
- “Owners not sharing money with the workers.”

- “I think, too, the movie industry has really led us to believe that coal mining towns are depressing places to be.”

Underground mining, particularly coal mining, is believed to be a dangerous business. There is concern about mine collapse and long-term damage to workers’ health.

- “I view it as real dangerous, a lot of people being hurt. It seems that there are many people dying in the coal mines and people dying from what’s in the coal mines.”
- “The canaries. They used to let the canaries in there to see if it was safe. That is the only thing I keep thinking of. Send a bird in.”
- “Coal miners’ lung disease.”

The public believes mining has little personal benefit to the individual

People do not know what products and services come from mining, so they place little positive value on mining. They do not know how mining affects the general economy or daily life. When they see how mining affects them, they are likely to be aware of only the most basic facts. This lack of information provides a golden opportunity for creating more positive attitudes.

- “I do not really think it affects modern life. I do not think it really has affected my life at all.”
- “Dying industry ... When I think of coal, I think of using coal for a steam engine.”

What are people getting in exchange for the harm they perceive to the environment, workers and local communities? They have no understanding of how mining affects their lives. This can only

Perhaps we should answer with a question: Would we be better off now if Stone Age toolmakers had used less flint?

Should Society Curtail Mining?

By Julian L. Simon

I consider a typical warning that we are running out of resources. This one by Paul Ehrlich, the best-known doomsayer.

In the early 1970s, the leading edge of the age of scarcity arrived. With it came a clearer look at the future, revealing more of the nature of the dark age to come.

By now every schoolchild believes we are entering an age of scarcity in which our finite natural resources are running out, our environment is becoming more polluted, and population growth threatens our civilization and our very lives. The belief reverberates in conservation policies set by the federal government and by the states.

Should we cut back on our use of natural resources? The politicians’ crude answer is an unequivocal “yes.” However, our use has been held all too often by law. The politicians have cut back on their use of fire because supplies were becoming scarce. Why would Great Britain have been better off if it had cut back on its use of coal during the age of scarcity?

(Homestake Mining Co.) and a six-minute clip from the early stages of Common
### Table 1. Employment in Mining: Selected Countries, 1985-2000('000)

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<td>88.7</td>
<td>77.1</td>
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<td>62.3</td>
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<td>61.1</td>
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<td>1.7</td>
<td>n/a</td>
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<td>130.3</td>
<td>92.6</td>
<td>52.6</td>
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<td>India</td>
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<td>27.1</td>
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<td>1.4</td>
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<td>343.8</td>
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#### U.S. Department of Labor
Bureau of Labor Statistics

**Occupational Outlook Handbook**
What to Do – Press the Message On ...

- Mining’s role in society, and how done
- Mining Engineering’s programs … yeah, explosives engineering, too
- What do students do here? It’s fun!
- Opportunities: employment, summer work, and scholarships
### Table 2. Mining's Contribution to GNP for Eight Countries (1998)(1)

<table>
<thead>
<tr>
<th>Country</th>
<th>Mineral Output (million $) (2)</th>
<th>Mining Employment (3)</th>
<th>US $ Generated Per Worker</th>
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<td>Australia</td>
<td>16,311</td>
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<td>United States</td>
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<td>Canada</td>
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<td>China</td>
<td>80,208</td>
<td>5,228,000</td>
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(1) Does not include aggregate mining.
Figure 1: Use of materials in the United States, 1900-1995 (Source: United States Geological Survey, 1998).
Mining's Role in Sustaining Society Today and in the Future

Jobs are booming in the mining industry. It started two years ago, when the prices for nearly all commodities increased and a large number of by-products began selling. Mining new minerals and technical professional staff is a new area, and mining companies are focusing on new strategies for mining engineering disciplines. Eleven accredited programs exist in the U.S. and UMC's program is recognized as one of the best by a number of people.

Mining's role in society is to provide a vast amount of minerals and energy resources, as demanded by people. A core question that lies at the heart of sustainability is: Over time, how much natural resources should be provided to meet human demands but also preserve public health and maintain ecological balance? The question is not easily answered, as it is complicated by inequalities across the world, and rationalizing trade-offs among peoples and nations is paramount to achieving sustainability for future generations.

Mining engineers plan, design and manage operations and companies that secure raw materials for society. As shown in Figure 1, the consumption of materials has increased dramatically over the past 100 years, and all signs indicate that human demand for materials won't subside.

The well-known goals of sustainability and the trade-offs among them drive the operational and planning processes of the mining industry and they require holistic design of engineered systems. This is no easy task, and the training of mining engineers requires an awareness of changing natural conditions and sensitivity to restoration of the disturbed earth to its original state. Operations must be profitable at the same time, and they are, like all industries, heavily regulated.

The U.S. Mining Industry

Just as the Navy, Air Force, occupational health and safety professionals, and other fields specialize so do mining engineers. The industry employs around 300,000 workers, including mining engineers, which places it among the largest U.S. Navy's workforce, and establishes it as an efficient sector:

- The following bullet points can be cited concerning the mining industry:
  - The world's largest one is here in the United States.
  - It continues to provide 60% of non-food.

Figure 1: Use of materials in the United States, 1900-1995 (Source: United States Geological Survey, 1998).

Figure 2: Incidence rates for fatal occupational injuries in private industry by major industry division, 1995 (Source: U.S. Department of Labor, 1996).

What to Do – Important Role in Society

U.S.M.'s Engineering Department

Students should also know that UMC's Mining Engineering Department is outstanding, with the following characteristics:

- By reputation, it is likely the best one in the United States, and maybe the world.
- It works closely with its students and nurtures their professional and social activities.
- It provides generous scholarships from industry and significant money for student activities.
- It has its own Experimental Mine for hands-on learning.
- It has a world-class faculty with extensive experience in industry and government.
- It offers optional specialty areas in exploitive engineering, quarry engineering, and coal, with policy-related options.
- It offers exchange program and permanent employment opportunities in Australia, Chile, and South Africa.

The Department works closely with its students every year, 17% of them women, and looks for opportunities for an exciting career for all students. Of the current 13 at 22 graduates per year, 100% have been placed in jobs for the last 50 years, for these numbers every year. They are everywhere in the U.S., Europe, and Latin America. This is a unique opportunity. Depending on location, they would like to have at least twice as many graduates per year if they were available.

For more information contact:
R. Larry Grayson
Chair, Mining Engineering Program
Phone: 341-4753
Email: graysonl@umr.edu

Paid Advertisement by UMC's Mining Engineering Program
Earth

-- and the many challenges of human demands and interactions
The Role of Mining – Minerals and Energy – in Sustaining Society

... and what its real impact is.
What is “sustainable development”? ... a notion that there may be limits to growth and that society must be reorganized to protect the interest of future generations ... Many government organizations, non-government and industry ones have different definitions.
Over a lifetime, on average an American infant will require (lots of materials here):

- 800 lbs of lead
- 1,500 lbs of copper
- 3,593 lbs of aluminum
- 32,700 lbs of iron
- 26,550 lbs of clays
- 28,213 lbs of salt
- 1,238,101 lbs of stone, sand, gravel and cement
NRC Committee on Material Flows Accounting of Natural Resources, Products and Residuals

Committee on Earth Resources Board on Earth Sciences and Resources
Raw Materials Extraction → Raw Materials Processing → Product Manufacture

Recycle → Reman. Reuse → Collection and Processing → Product Use - Services

Air, water, land
Figure 4.1  US coal system, 1993 (MMT)
Coal material flow analysis – modified

Figure 9. Coal material flows analysis for 1993 (modified flows in MMT).\textsuperscript{15}
Mining Operations

13,902 Total Mining Operations
(spotted randomly within counties)

Source: MSHA 1998
Average benchmark annual salaries at U.S. aggregate and construction material mines and U.S. coal mines (114 mines).

<table>
<thead>
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<th>Coal Mines</th>
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<td>General Manager</td>
<td>$85,300</td>
<td>$114,800</td>
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<tr>
<td>Mine Manager</td>
<td>70,300</td>
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<td>Mine Superintendent</td>
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<td>Plant Foreman</td>
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<td>Chief Geologist</td>
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<td>Purchasing Agent</td>
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<td>55,100</td>
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<tr>
<td>Environmental Coordinator</td>
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A CLASS THAT'S A BLAST

MAY 2005—RALEIGH, NC. Professor Reid W. Wynn is helping students better understand the science, technology, and business of pyrotechnics. He teaches at the University of Missouri-Rolla (UMR), the school where pyrotechnics as an area of study is made available. Wynn has been teaching pyrotechnics for 16 years, and during that time he has helped hundreds of students prepare for careers in the field.

The course is an outgrowth of Wynn's work with UMR's Explosives and Pyrotechnics Engineering project. He has been working on engineering applications for pyrotechnics, studying the use of pyrotechnics in cutting-edge technology, and designing new pyrotechnics-based products. Wynn is also the author of a textbook on the subject of pyrotechnics, which is widely used in the classroom.

During the course, students will learn about the science and technology of pyrotechnics, including the principles of combustion, thermal chemistry, and safety. The course also includes practical experience through a series of hands-on projects, allowing students to apply what they have learned in real-world situations.

Wynn encourages students to think critically about the role of pyrotechnics in society, and to consider the ethical implications of using these technologies. He believes that understanding the science and technology behind pyrotechnics is crucial for making informed decisions about their use.

For more information about the course, please contact Reid W. Wynn at wynn@umr.edu.

2005 Summer Explosives Camp

2004 Fireworks on UMR campus

July 17 – July 21, 2005

Commercial Pyrotechnic Operations

"PGI Shooters Certification"

September 15 – November 24, 2004
Richland, MO

Presented by University of Missouri-Rolla

Rocks, Mechanics & Explosives Research Center

in coordination with

Premier Pyrotechnics Inc.
Mining Engineering in school can be a challenge

Where will your degree take you?
International Intercollegiate Mining Competition ... fun
Student Chapters and Fund Raisers
=> Leadership

Society for Mining, Metallurgy and Exploration, Inc.
National Stone, Sand and Gravel Association
International Society of Explosives Engineers
Women in Mining

9th Annual Haunted Mine
October 22, 2004 - 6:00 pm – 11:00 pm
October 23, 2004 – 5:00 pm – 11:30 pm
October 29, 2004 – 6:00 pm – 12:00 am
October 30, 2004 – 5:00 pm – 12:00 am
University Economics

- Clamor for very limited resources
- Metrics tough to meet
  - 15 to 1 student ratio to faculty FTE
  - $250K research expenditures/FTE
  - Department size 200 to 300 minimum
- Tuition & Fees fast rising; political limits
- New revenue sources critical
# Show Progress or ... Die

## Table 1. Enrollment Progress

<table>
<thead>
<tr>
<th>Year</th>
<th>U/G#</th>
<th>Fr Eng+</th>
<th>Total</th>
<th>U/G</th>
<th>PhD*</th>
<th>MS*</th>
<th>ME*</th>
<th>Total Graduate*</th>
<th>Grand Total</th>
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<td>3</td>
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<td></td>
<td>24</td>
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</tr>
<tr>
<td>2002</td>
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<td>18^</td>
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<tr>
<td>2001</td>
<td>59</td>
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<td></td>
<td>13</td>
<td>91</td>
</tr>
</tbody>
</table>

- Merged with Nuclear Engineering => doubled enrollment
- Tripled grant and contract awards => $5.2 million FY05
- Tripled PhD students
- Tripled Master of Engineering (ME) program
However ...

- Dearth of federal research monies dedicated to mineral resources
- Lack of expertise in faculty, e.g., ventilation expertise dying fast
Summary of Keys to Recruiting Students into Mining Engineering

- Clearly demonstrate care and concern for students; faculty and staff address needs or problems personally, straightforwardly and quickly; they are our customers

- Build a family, spend some time with them all, building enthusiasm and empowering them toward the common goals; yes, our students are our best recruiters
Summary of Keys to Recruiting Students into Mining Engineering

- Act immediately on every inquiry, walk-in or electronic, and give priority to them; this includes industry and citizens as well as students
- Explain the discipline’s important role in society briefly and appealingly
- Have some fun at times, give options for it
Summary of Keys to Recruiting Students into Mining Engineering

- Have some student-run and student-oriented functions/activities with leadership roles
  - Haunted Mine
  - Mucking Competition
  - Mine Rescue
  - Mine design competitions
  - Student Awards Banquet
  - Fireworks shows at university events
  - Multiple student chapter options
Summary of Keys to Recruiting Students into Mining Engineering

- Share everything with industry partners; keep industry coming back, making presentations, and recruiting; visit them regularly; keep students informed of opportunities

- Advertise innovative programs, research, and student activities at every opportunity

- Collaborate across disciplines

- Maintain a strong alumni network, including a job pipeline; it works both ways – you get them new jobs, and they hire your students