

Occupational Health and Safety in the Formal and Informal Mining Sectors: A Critical Factor in the Sustainable Development of Mineral Resources



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Occupational Health and Safety

- Protects and promotes worker health through prevention and control of occupational illnesses, injuries and fatalities.
- Develops and promotes healthy and safe work practices, work environments and work organizations.
- Enhances the physical, social and mental well-being of workers.
- Enables workers to live socially and economically productive lives.



“At the core of SD is the idea that any human activity, including mining, should be undertaken in a way that the activity and its outcomes produce a net positive long-term contribution to human and eco-system well being.”

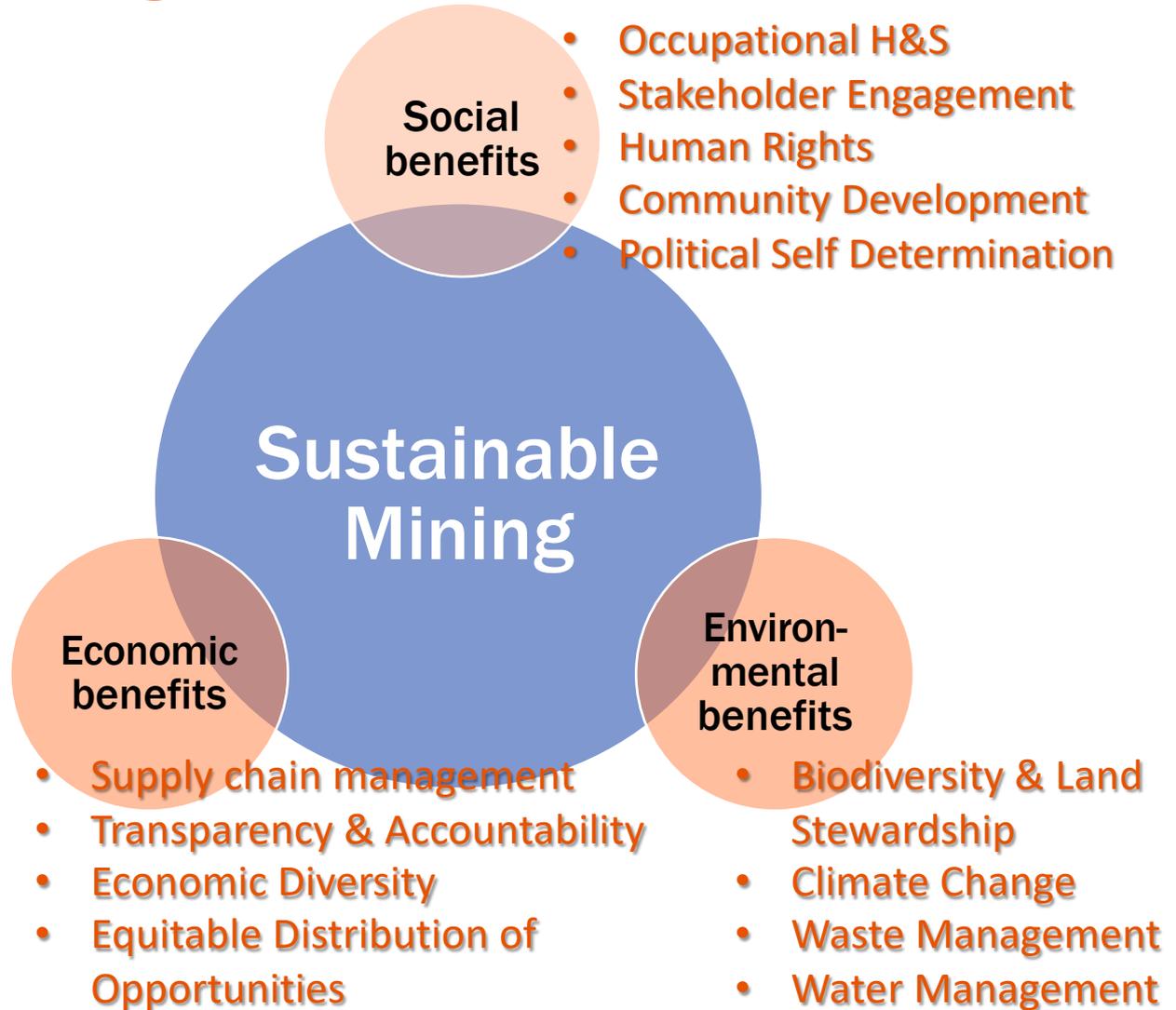


<http://www.icmm.com/website/publications/pdfs/3716.pdf>



A Global Challenge

- The global supply of minerals is finite.
- Demand is expected to increase.
- Mining will shift from developed to developing nations.



There are two mining sectors

FORMAL:

The formal sector consists of the businesses, enterprises and economic activities that are monitored, protected and taxed by the government.



INFORMAL:

The informal sector is comprised of workers and enterprises that are not under government regulation. This sector is:

- growing globally
- the majority of the economy in Latin America and Africa

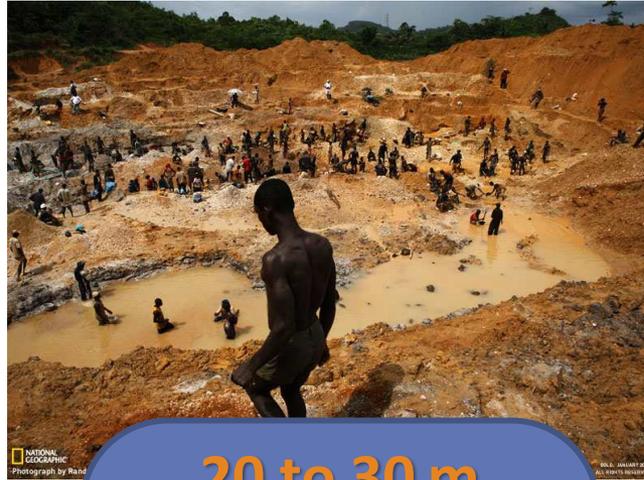


Formal Mining Sector



2.5 m
employed world wide
6000
companies

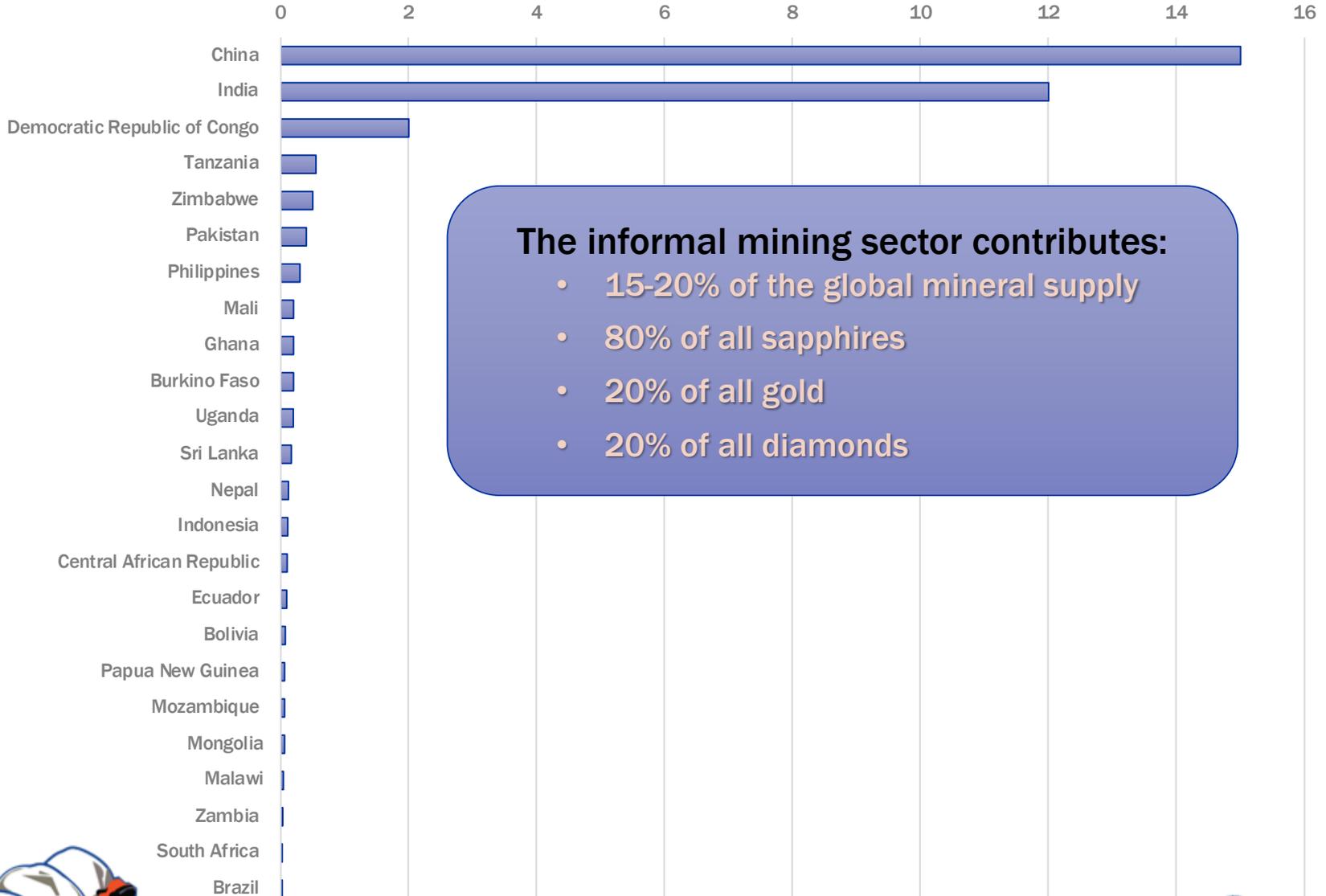
Informal Mining Sector



20 to 30 m
miners operating in
80
countries
50%
are women
80 to 100 m
depend on IM for
their livelihood



Number of Miners Working in the Informal Sector (millions)



The informal mining sector contributes:

- 15-20% of the global mineral supply
- 80% of all sapphires
- 20% of all gold
- 20% of all diamonds

The formal and informal mining sectors operate under two very different sets of circumstances

Formal Mining	Informal Mining
Operates under legal and fiscal frameworks determined by local and national governments	No legal or fiscal framework.
Highly mechanized and technology driven operations that seek to minimize social and environmental risk.	Associated with severe social, environmental, and security risks. <ul style="list-style-type: none">• Crime, corruption, conflict• Marginalized and vulnerable workers (children, women)• Gender inequality• Economic insecurity
High capital investment, high productivity, global distribution and logistics chains	Poor access to financial services, market information, technology and data. Low productivity and use of informal marketing channels.
Well established occupational health and safety programs.	Lack of occupational health and safety protection.



The informal sector is often cast in negative terms only. Some potential positives:

- Uses less energy per unit of ore
- Releases fewer green house gases per unit of ore
- Produces less waste and tailings
- May improve resource efficiency
- Provides immediate and direct impact to local economy
- Is increasingly recognized as a way out of poverty
- Innovative, entrepreneurial, dynamic
- Socially relevant rules, processes and regulations based on social and cultural tradition



Formal Mining Sector H&S Landscape

- Strong Government Commitment to OSH

- ❑ Effective regulatory framework
- ❑ Significant investment in OSH R&D

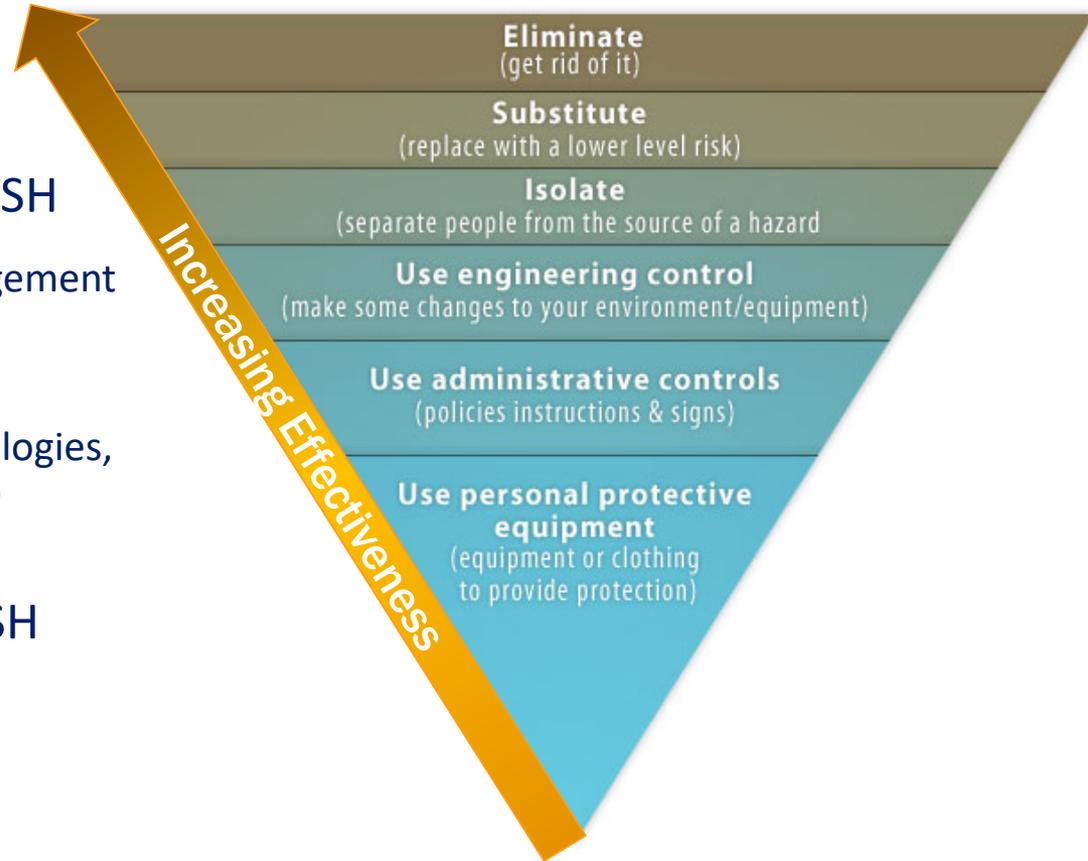
- Strong Industry Commitment to OSH

- ❑ Training, company policies, and management practices
- ❑ Access to OSH controls
- ❑ Safe working conditions (smart technologies, sensors, automation, person-wearable monitors)

- Strong Worker Commitment to OSH

- ❑ Safety first

Hierarchy of Controls



The changing nature of work in the formal sector is creating new occupational hazards

- Increased mechanization
- Automation (mixed work environments)
- More contractors (mixed work force)
- Extended work shifts

Risk Management
Safety Culture
Competency Based Training

- **MSD's**
- **Cognitive Overload**
- **Fatigue**

Human Centered Design
Human Factors



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Informal Mining Sector H&S Landscape

- Heavy work/extreme physical exertion
- Poor working conditions
- Lack of access to PPE or other controls
- No legal/regulatory protection
- Little to no OSH training or knowledge
- Overlap between work and living environment
- Entire families may be involved in mining activities
- No government worker compensation programs

“Hazards faced by formal workers are multiplied several-fold for informal workers” *

*Elgstrand et al 2017, Safety and Health in Mining: Part I



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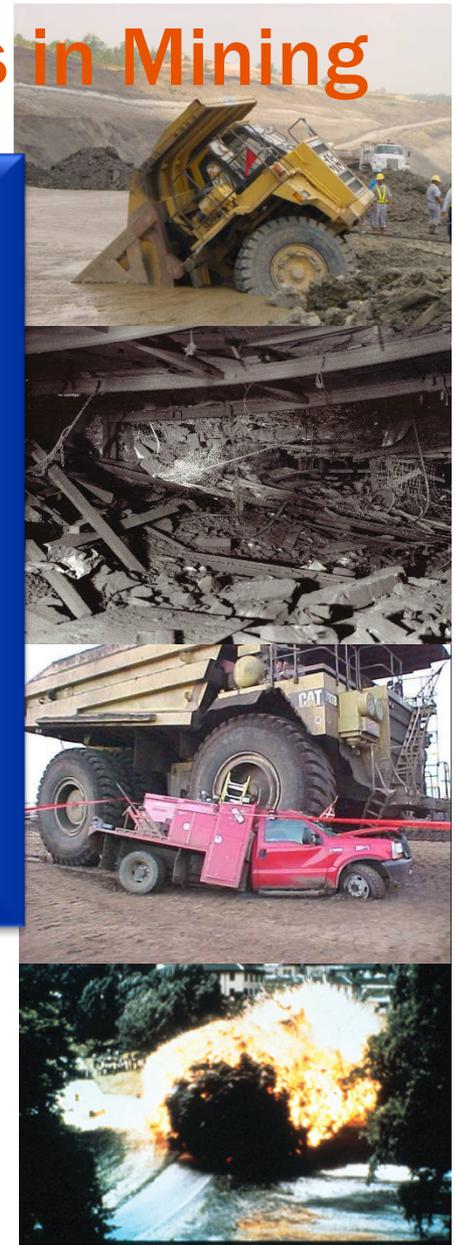


Occupational Health and Safety Risks in Mining

- Ground failure
- Fires & Explosions
- Slips, Trips, Falls
- Electricity
- Mobile Equipment
- Fatigue and Cognitive Impairment
- Exposure to:

- Noise
- Heat and/or cold
- Vibration
- Dust (i.e. coal, crystalline silica, asbestos)
- Toxic Substances (i.e. Hg, Pb, DPM)
- Gases

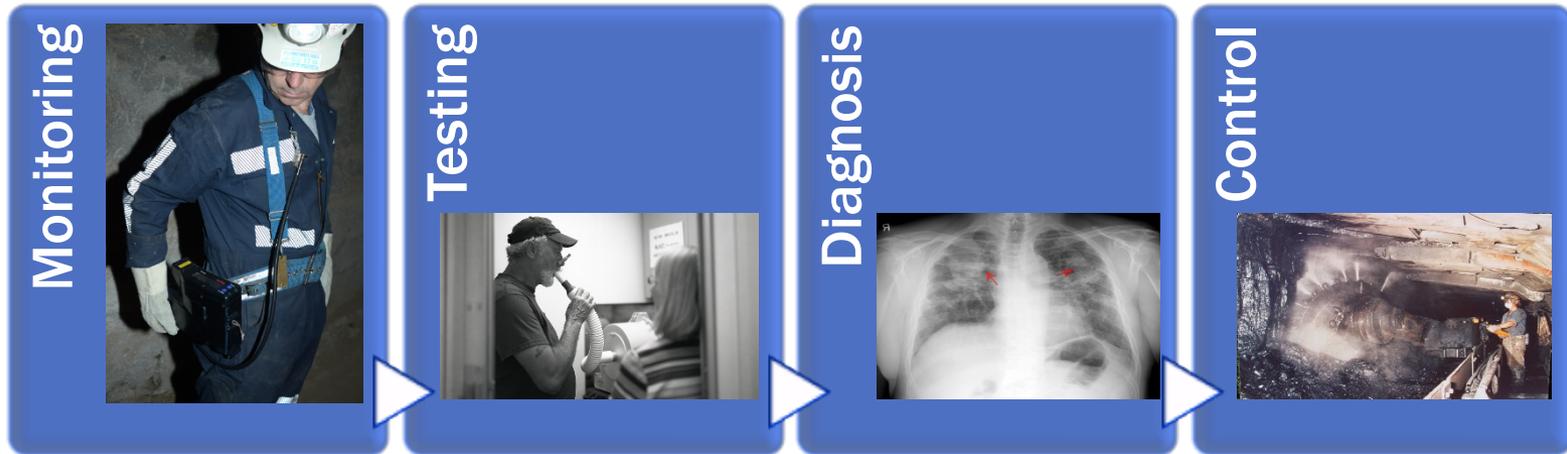
US miners are 3.5X's more likely to die on the job than workers in all private industry



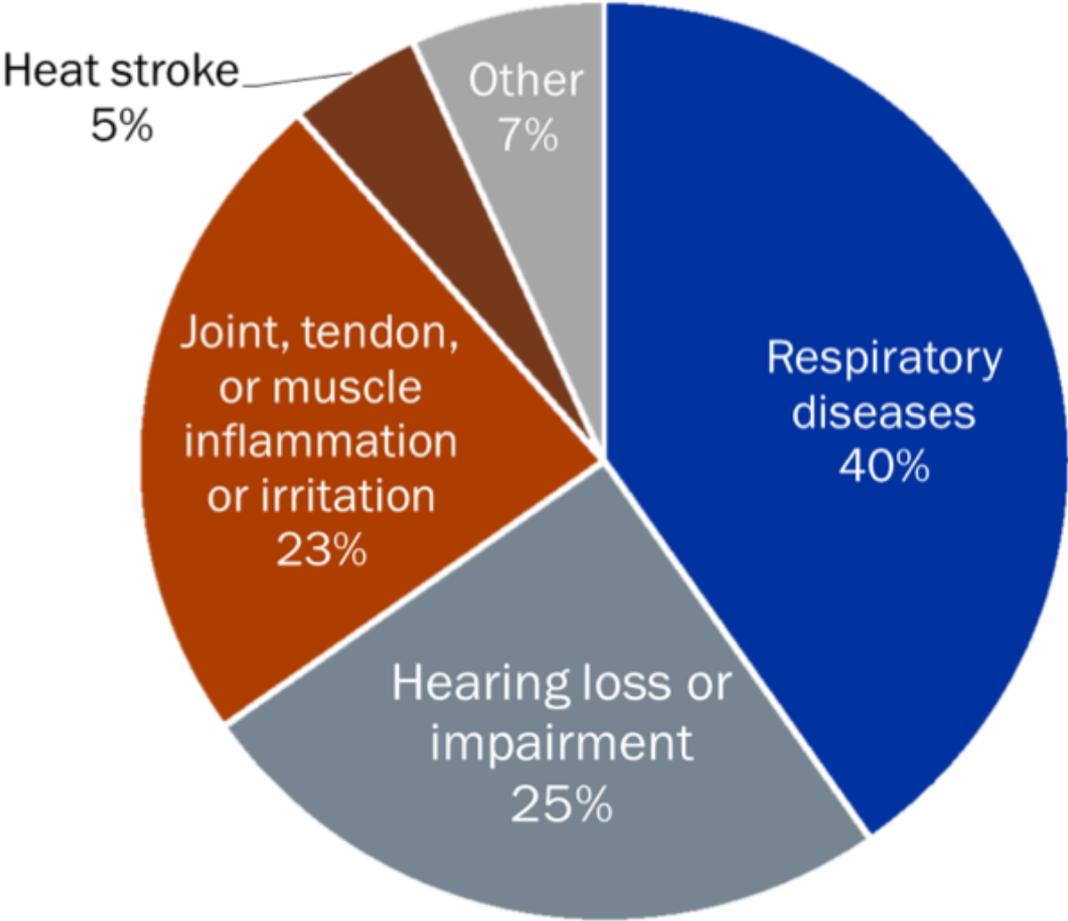
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Occupational Health in Mining

- Occupational health risk is not as well understood as safety risk:
 - Lack of universal and regular health surveillance
 - Limited availability of occupational health professionals especially in developing countries and rural areas
 - Complex relationship between health consequences of occupational and non-occupational exposures



Occupational disease in US Miners (2015)



www.msha.gov



Hearing Impairment in US Sand & Gravel Workers

2004 assessment of noise and hearing loss among sand & gravel miners:

- **69%** of worker's noise exposure exceeded recommended limit
- Significantly higher noise exposures occurred among employees of small companies
- **48%** of subjects reported never using hearing protection
- **37%** of workers had hearing impairment

Landen D, et al. Noise exposure and hearing loss among sand and gravel miners. J Occup Environ Hyg. 2004;1(8):532-541.

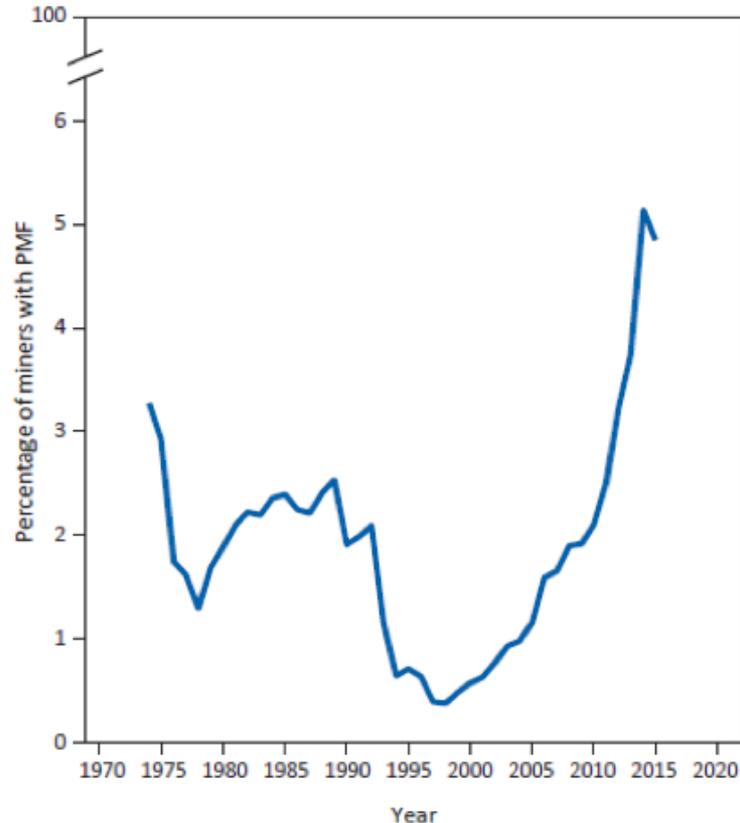


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Black lung disease is re-emerging in the US

FIGURE 1. Prevalence of progressive massive fibrosis (PMF)* among underground-working coal miners with ≥ 25 years of underground mining tenure — Coal Workers' Health Surveillance Program, Kentucky, Virginia, and West Virginia, 1974–2015



Source: Blackley DJ, Halldin CN, Laney AS. Resurgence of a debilitating and entirely preventable respiratory disease among working coal miners. *Am J Respir Crit Care Med* 2014;190:708–9. Adapted with permission.

* Data are 5-year moving average (e.g., data plotted for 1974 = $[PMF_{1970} + PMF_{1971} + PMF_{1972} + PMF_{1973} + PMF_{1974}] / [Total\ participants_{1970-1974}]$); surveillance is conducted on a 5-year national cycle.

FIGURE 2. Photographs of workers and equipment under typical conditions in an underground coal mine*



Crystalline silica exposure may cause multiple diseases

Exposure to Crystalline silica dust causes:

- silicosis
- silica dust-associated TB

Both diseases are high on the list of occupational health priorities in developing countries.

The prevalence of silica-related TB is exacerbated by the HIV epidemic in developing countries.

Fig 5



- The state of Rajasthan produces approximately 90% of India's sandstone
- One-third of the population depends on mining for their livelihood

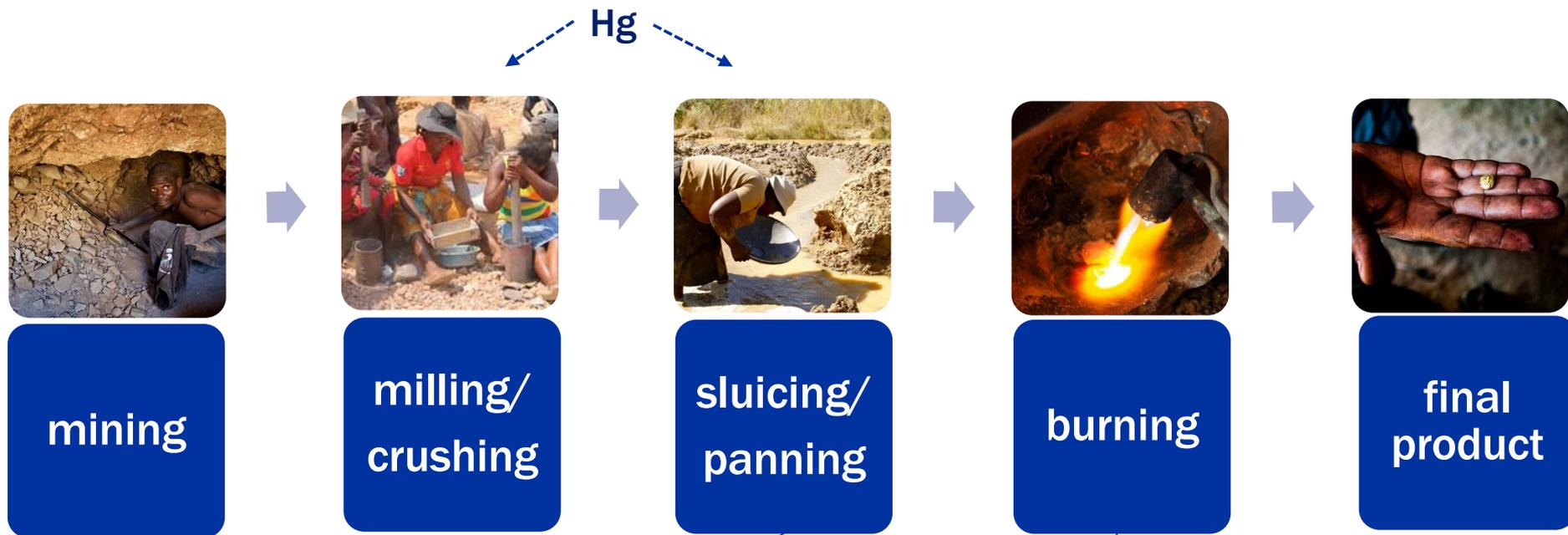


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Ahmad, A. , 2015, Silicosis, Mining, and Occupational Health in India's Sandstone Industry, EHS Journal.



Mercury pollution from informal gold mining has global effects on human health



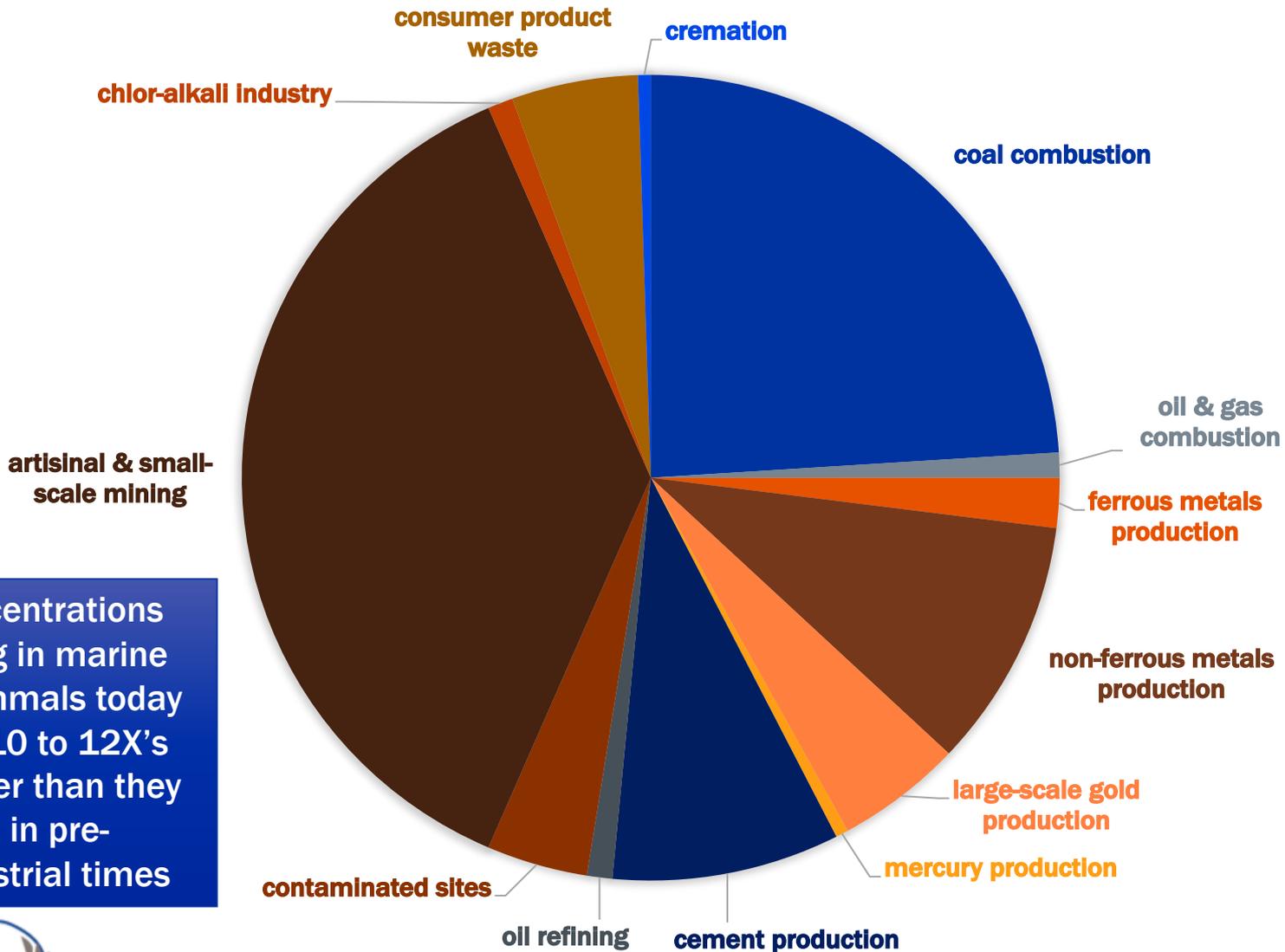
Fish contaminated with Hg is the main protein source for many communities



Mercury contaminated tailings in Peru.



ASM is the largest anthropogenic contributor of Hg to the atmosphere



Concentrations of Hg in marine mammals today are 10 to 12X's higher than they were in pre-industrial times



Responding to occupational health and safety challenges in the informal sector

- Organize local and regional cooperatives
- Work with local and regional governments to pave the way to formalization
- Capacity building on the ground – best practices, technology implementation
- Raise awareness through targeted interactions with affected communities
- Build knowledge networks to support miners and influence policy makers
- Engage and empower miners



Occupational health & safety improvements provide long term benefits to workers, the environment and communities



NIOSH Mining Program – www.cdc.gov/niosh/mining



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