Mine Ventilation – The Future

Ventsim User Conference Sept 2023

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Photo: Fluid Flow Heat & Mass Transfer

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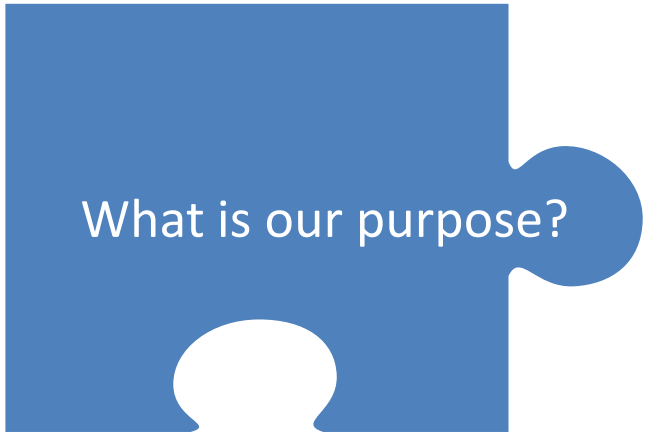
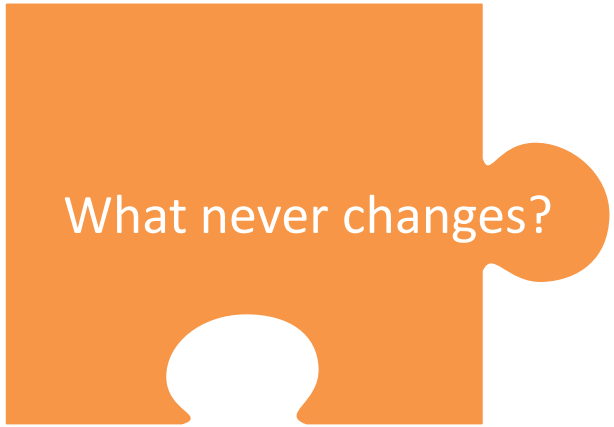


Designing and **managing** systems that protect employees.



Air is required for life – ventilation systems are a **primary safety control** in underground mines.

Environmental Targets
Safe Work Environment
Supply Chain Partners
Research/Academia
New Strategy

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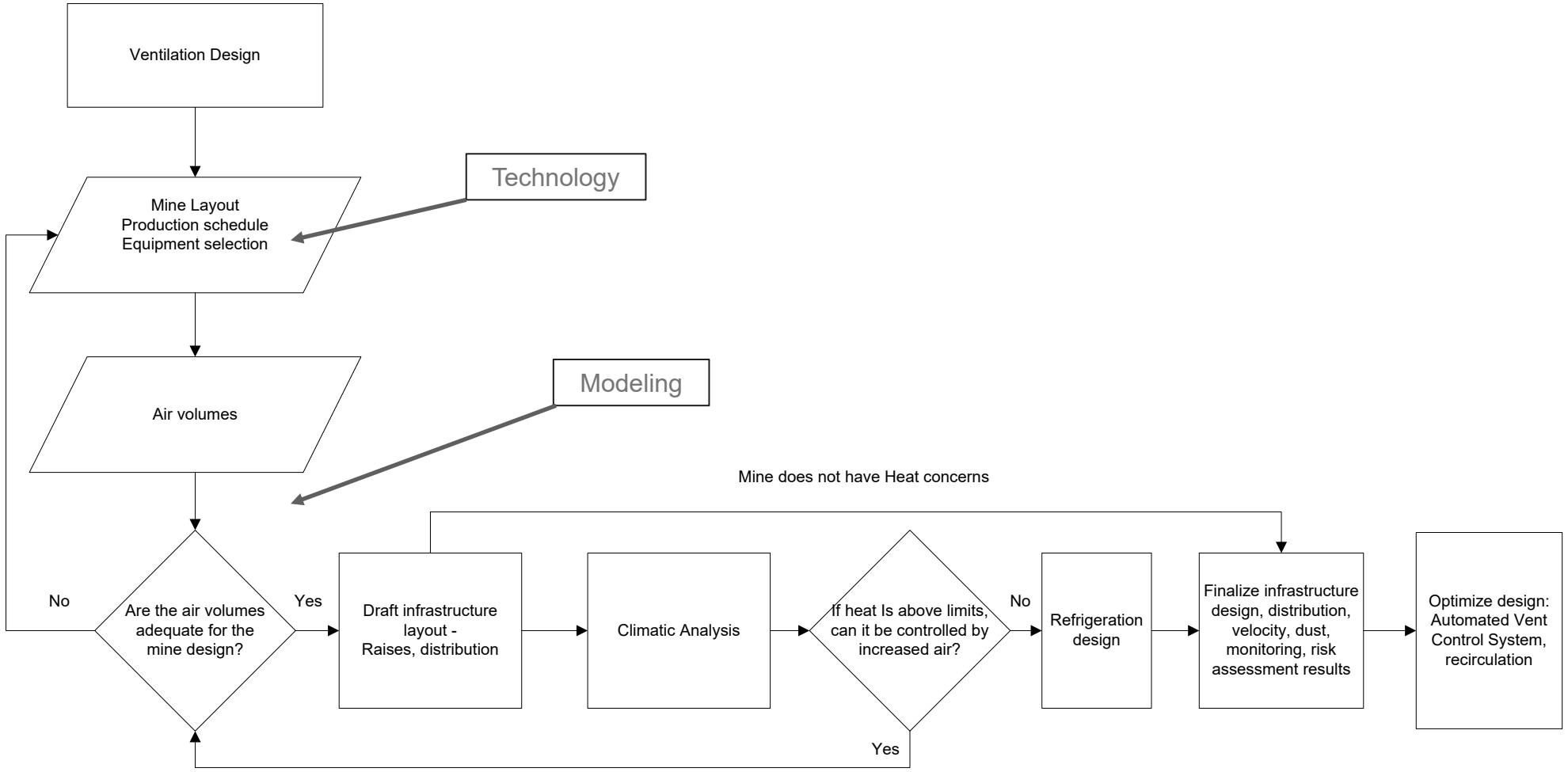
Introduction - Ventilation Design & Modeling



Health Safety Environment - HSE

Well-being in the Workplace

- Identify potential hazards, minimize those hazards, continuously assess risk
- Both physical and mental well being
- What organizations must do to ensure their activities do not cause harm to anyone

Minimize the Environmental Impact where We Operate

- Innovative and proactive strategies to reduce pollution, climate change, loss of biodiversity and promote sustainable practices
- Care for our employees and community
- Good environment = good health

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Environment - Net Zero

Mining is required for products that support the world to achieve Net Zero Emissions

Why Net Zero

- Necessary to avoid conditions that will worsen climate change impacts
- Global problem
- Social Responsibility

Ideas

- Data Driven
- Circular Economy
- Hydrogen Fuel Cells over Li-Ion battery re-cycling issues
- Natural sources for conditioning the air before going underground

Challenges

- Supply chain problems, cost pressures, energy availability all challenge the best intentions
- Applied technologies need to be sustainable and reliable
- Understanding new risks with technology

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Reducing the Footprint

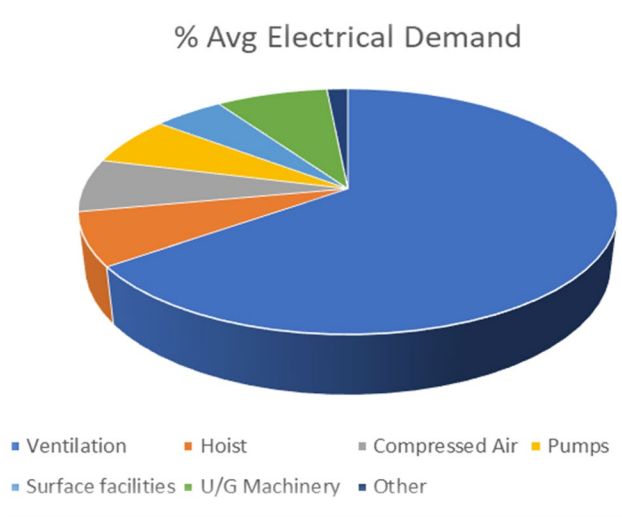
Ventilation Systems

Power Conservation

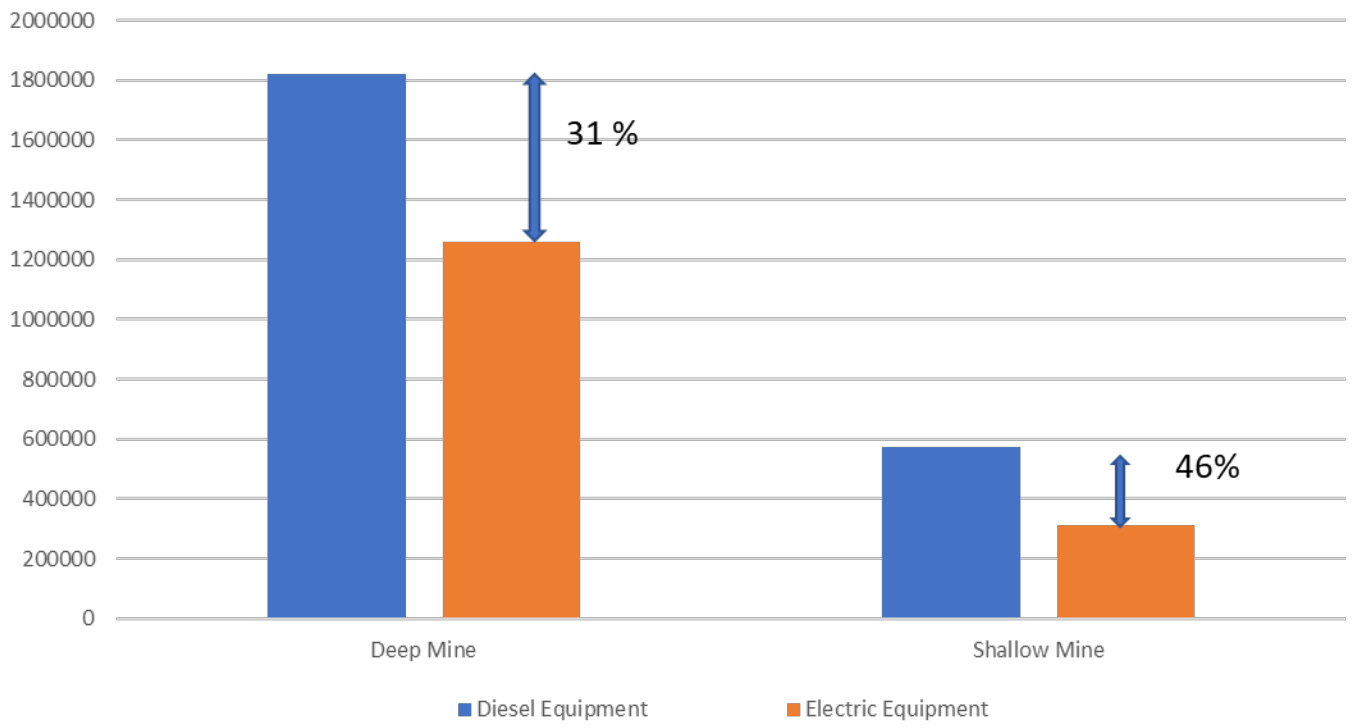
- Ventilation systems are 50% - 80% of a mine site power demand
- Technology used for moving personnel and materials can offer reduced air volume – BEV, Hydrogen Fuel Cells
- Technology to automate ventilation systems adapted to reduce power demand.
- Autonomous Mining – reduce power by moving material when no one is underground

Noise

- Main Fan locations, configuration, size, etc (surface/underground)
- Noise reducing technology part of the design
- Fan technology



Reducing the Footprint



Comparison of air volume reduction potential considering mine depth/ heat loads

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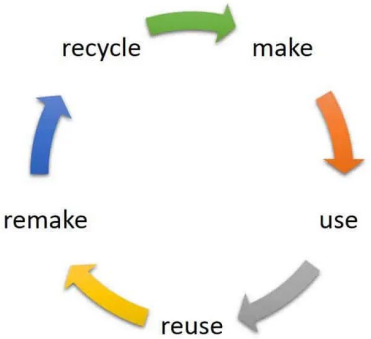
Environment - Circular Economy

What is it?

- Using resources wisely
- Economic system to eliminate waste and the continual use of resources. (Wikipedia.org)
- Nothing is waste - move away from a linear economy of extract, use, dispose



- Reusing, repairing, remanufacturing, repurposing, recycling
- Industrial waste being used for paving, concrete bricks, concrete and mortar, cement, plastic wood, sand, ceramics, artificial rock and agriculture
- Technology to re-cycle Li-Ion batteries

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Business - Data Driven

Good data is essential to make informed and sound decisions

Benefits

- Good data is essential to make informed and sound decisions
- The amount of data that can be processed today can generate precise answers superior to the use of representative data sets

Why is it hard?

- Becoming data driven requires a culture change
- Effort of change is underestimated
- Information often “de-centralized” with people choosing when, what and how to consume.
- Majority of data is unstructured and hard to quantify

Harvard Business Review, Data Management by R Bean

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Data Driven – Modeling Data Base

How are or can measured data become part of the vent design?

Data base development applied to modeling:

- Per mine site
- Per company
- Per country
- Per Mining Community

Analysis is necessary to ensure conditions are understood for the data applied – AI?

Challenges

Regulations

- Regulations keeping up with technology
- Internal standards and guidance
- Cyber Security

Technical

- Heat in deep mines, climates with high temperatures
- Northern climates that require cooling and heating at the same time
- Infrastructure age, degradation while implementing technology
- Mine expansion
- Process Control Underground

Challenges

Innovation

- Automation, mixed fleets
- Proven or Novel Technologies
- Cost – CAPEX and OPEX
- Modeling Approach and Vent Design
- AI

Business Case

- Effective Communication
- Available Data and analysis of data
- Supply Chain
- Industry Partners
- Funding Partners
- Open Sourcing

Journey of Change and Improvement

Act
- System Mgmt Changes
- Design improvements
- Model updates
- Technology improvements
- Trade-offs

Plan
- Strategy for vent design changes
- Strategy for technology
- Select Technology
- Business Case using data

Check
- Digital Mine data analysis
- Verify assumptions
- Modeling method
- Regulatory compliance

Do
- Model
- Data calibration
- Budget
- Implement technology
- Communication to stakeholders

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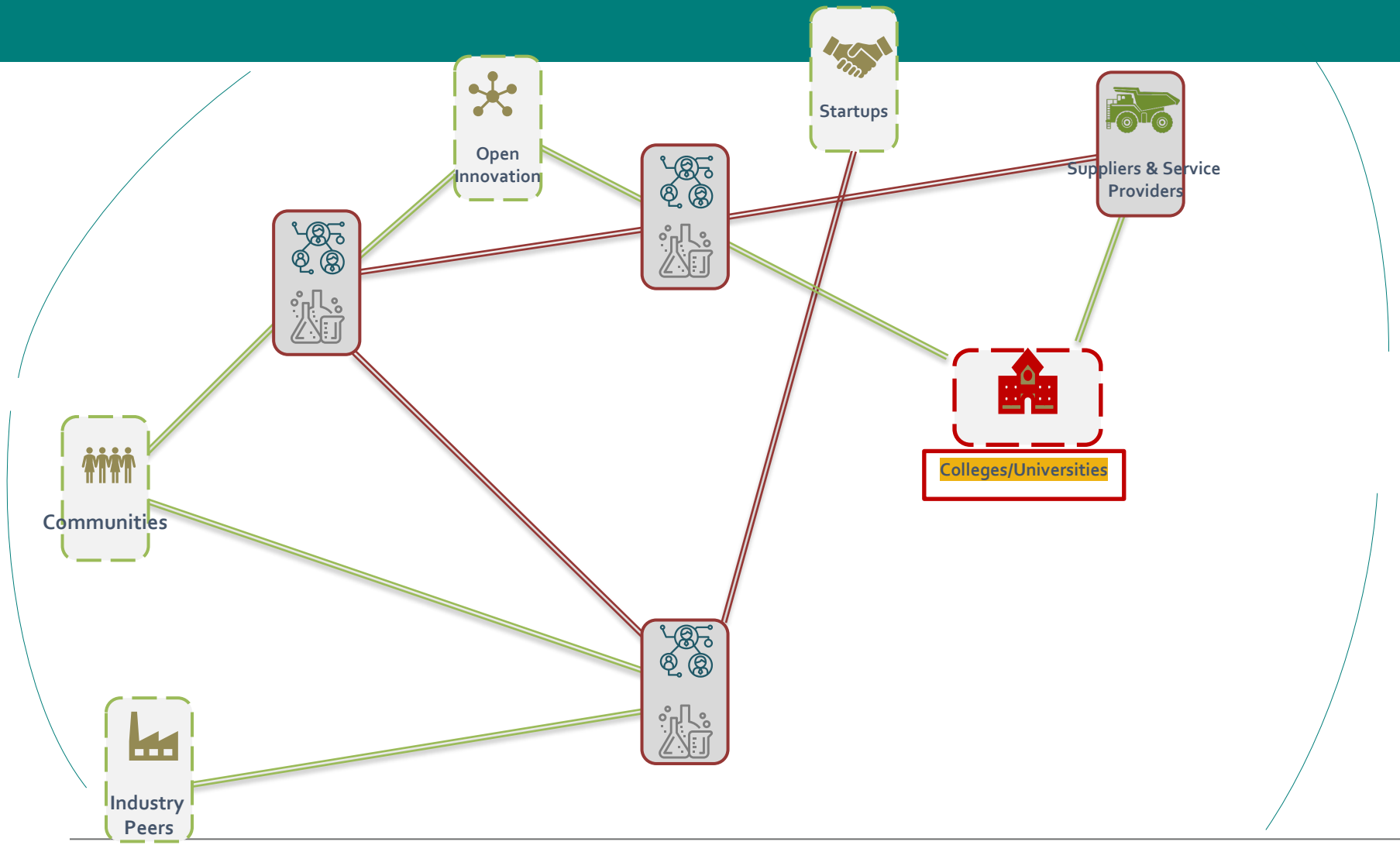
Conclusion

- Mining is required for products that support the world to achieve Net Zero Emissions
- Our purpose will not change
    1. designing and managing,
    2. air is required underground,
    3. employee well-being and care for the environment
- In driving for solutions, challenges will always be present
- The journey of change and improvement is a continuous loop

Thank you



Think Outside the Box
Be open to Options

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