

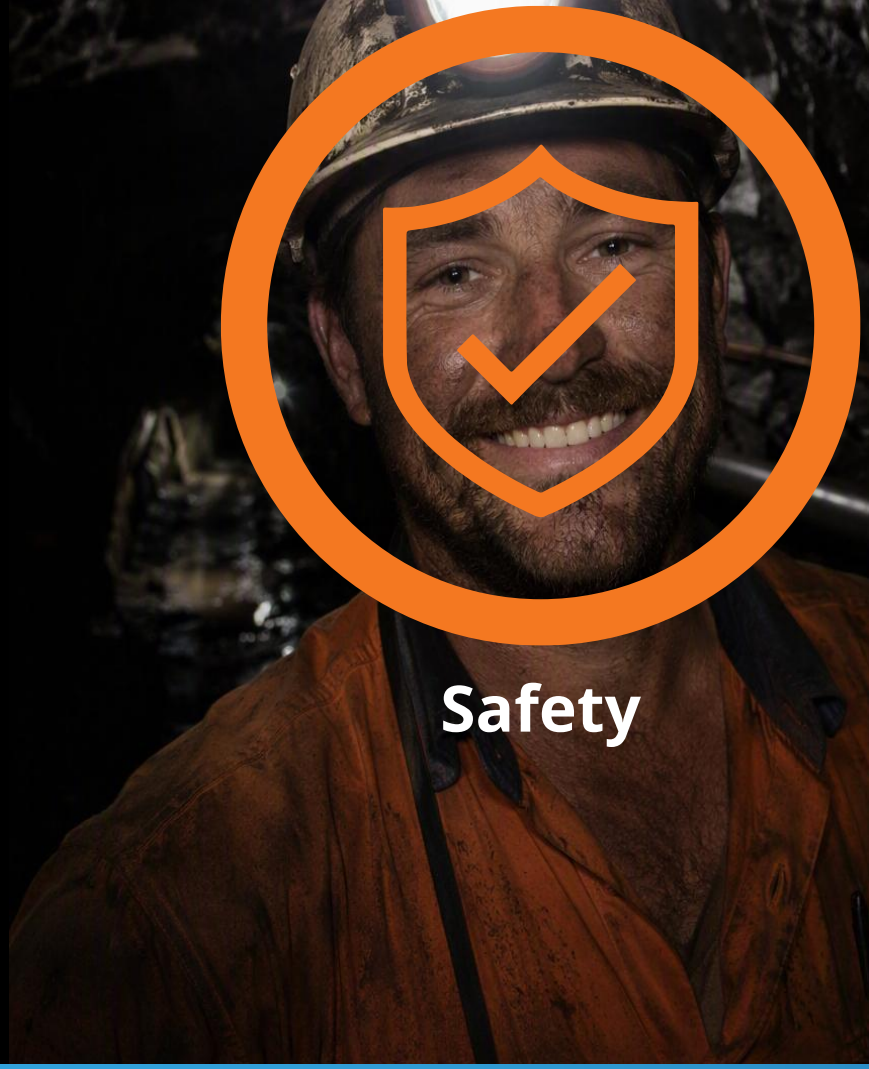
CHART Cooler By Design | Howden A Chart Industries Company

Sustainable Ventilation: From Engineered Fans to Intelligent Energy Savings

A Recent Customer Case Study

© 2026 Chart Industries, Inc. Confidential and Proprietary

Why Do We Need Ventilation?



Safety

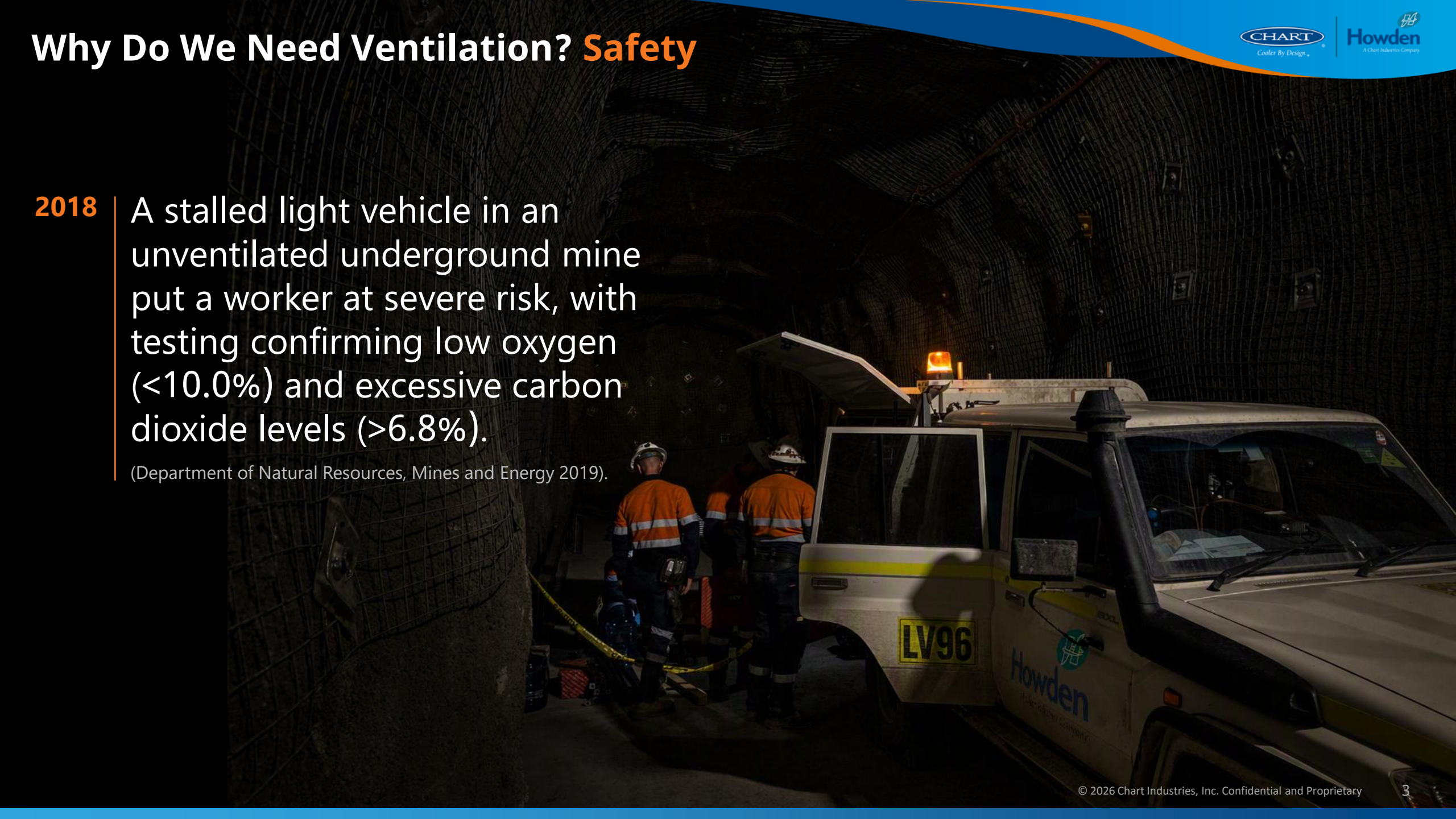
Productivity

© 2026 Chart Industries, Inc. Confidential and Proprietary

Why Do We Need Ventilation? Safety

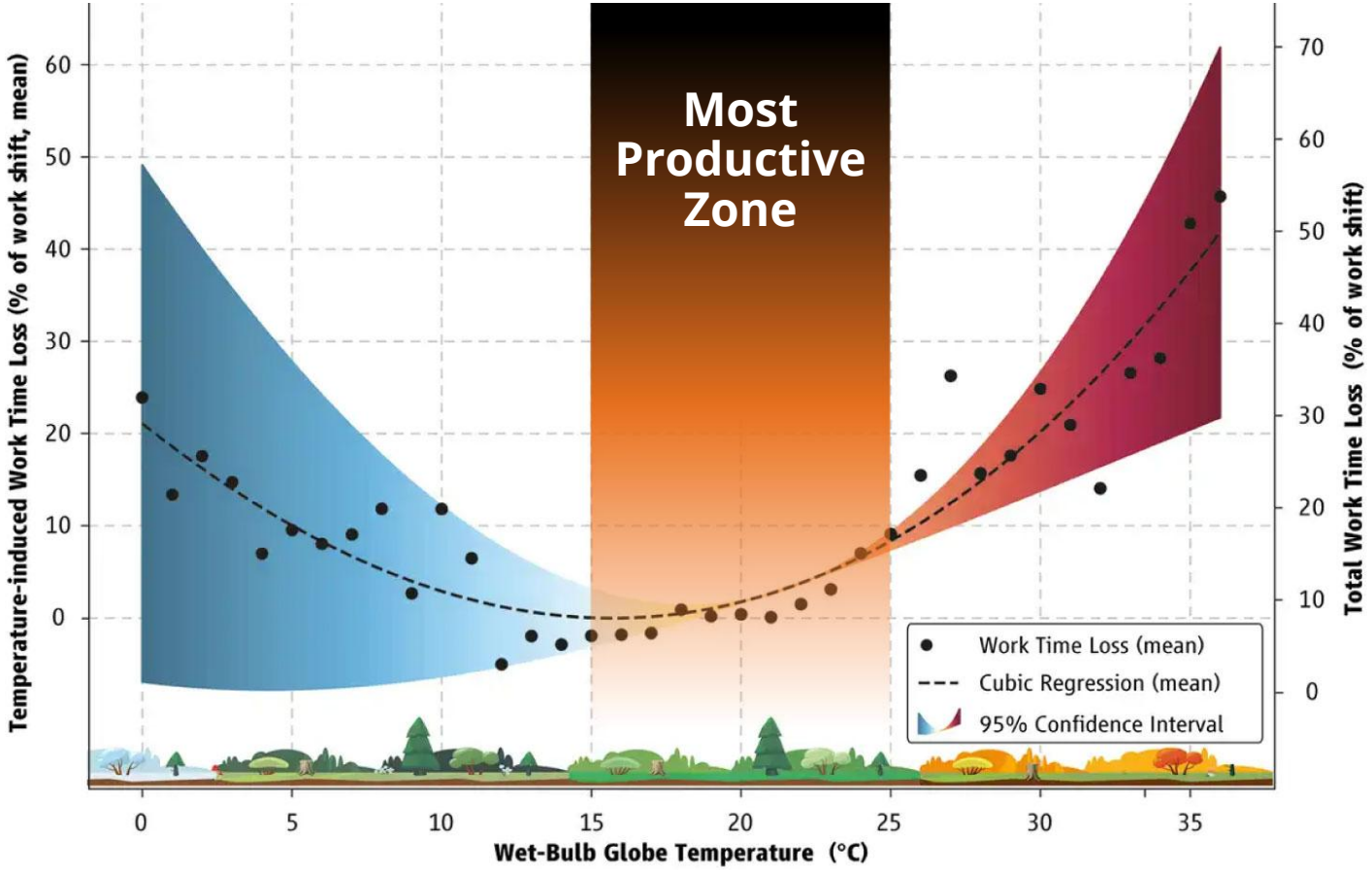
2018 A stalled light vehicle in an unventilated underground mine put a worker at severe risk, with testing confirming low oxygen (<10.0%) and excessive carbon dioxide levels (>6.8%).

(Department of Natural Resources, Mines and Energy 2019).



© 2026 Chart Industries, Inc. Confidential and Proprietary

Why Do We Need Ventilation? Productivity



(The Impact of Workplace Heat and Cold on Work Time Loss, Journal of Occupational & Environmental Medicine, pp. 393-399, 2025).

Without adequate ventilation, the impact is felt across:

People – lost hours, fatigue, & safety risk

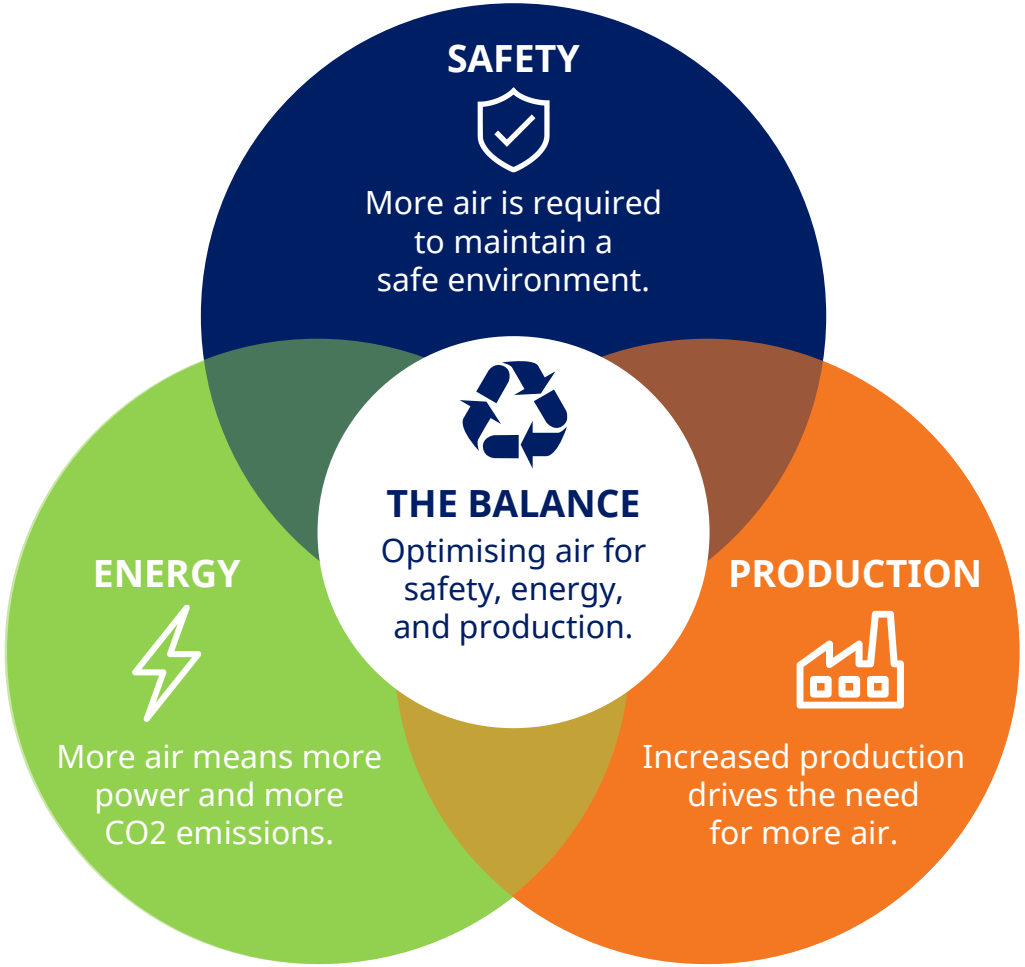
Machinery – reduced efficiency and faster wear

© 2026 Chart Industries, Inc. Confidential and Proprietary

The Ventilation Challenge & Why It Is a Sustainable Opportunity

Ventilation is the **single largest controllable energy load** in most underground mines.

Moving air is expensive, and every decision has a ripple effect across safety, energy, and production.



One change impacts all three.

© 2026 Chart Industries, Inc. Confidential and Proprietary

Engineered Foundations
Building the Right Ventilation Foundation

1 The role of correctly selected and engineered fans

2 Matching airflow capacity to the mine's operating needs.

3 The importance of system design, pressure, resistance, control points and reliable hardware.

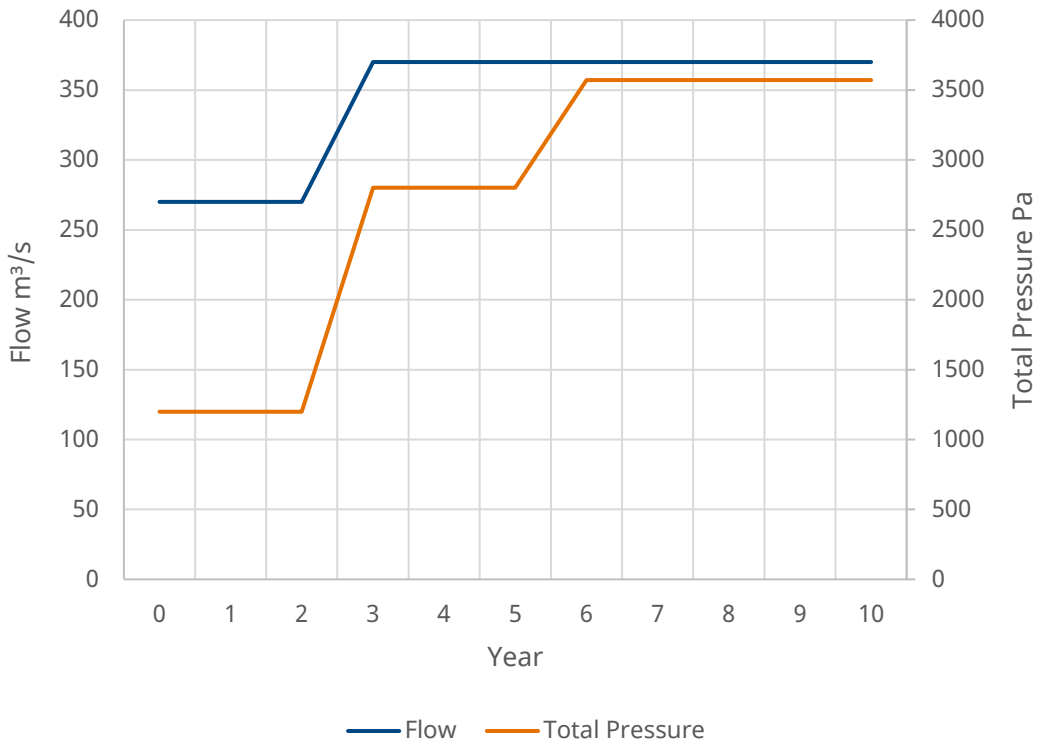


© 2026 Chart Industries, Inc. Confidential and Proprietary

The Problem

A 10-year duty profile with three very different constrained operating periods.

Flow vs Pressure for Life of Mine



Fan Duty Parameters

	Initial	Intermediate	Peak
Total Flow Rate	**270** m³/s	**370** m³/s	**370** m³/s
Total Pressure Req.	**1,199** Pa	**2,802** Pa	**3,571** Pa
Shaft Power (each)	353 kW	655 kW	798 kW
Total Efficiency	45.6 %	78.2 %	81.6 %
Period	0 - 2 Yrs	3 - 5 Yrs	6 - 10 Yrs

© 2026 Chart Industries, Inc. Confidential and Proprietary

Solving the Problem: Fan Selection

AXIAL FAN



High airflow. Lower pressure duties

PROS

- ✓ High airflow
- ✓ Efficient at low to moderate pressure
- ✓ Lower capital cost
- ✓ Compact and lightweight
- ✓ Adjustable blade pitch

CONS

- Limited pressure capability
- Wear and tear can create significant drops in efficiency
- Higher stall risk at high resistance
- Larger diameter fan needed for high-duty applications

MIXED FLOW FAN — SELECTED



High pressure. Stable across required duty range

PROS

- ✓ Higher pressure capability
- ✓ Stable at high resistance
- ✓ Wider efficient operating range
- ✓ Smaller diameter fan for equivalent airflow and pressure

CONS

- More complex maintenance
- Higher capital cost
- Heavier, more complex construction
- Lower airflow capacity than axial fan for equivalent diameter

The best combination of **pressure capability**, **operating stability** and **durability** to meet customer duties.

© 2026 Chart Industries, Inc. Confidential and Proprietary

Solving the Problem: Chosen Fan

Anti-Stall Chamber
Ensures stable operation across full duty range.

900 kW Motor
Meets the desired fan duty to the solve the problem at hand.

Inlet Radial Vane Control
Reduces power consumption without the costly addition of a variable speed drive to the system.



Inlet Bell & Diffuser
Improve aerodynamic performance, reduce system losses and improve performance.

Mixed Flow Impeller
Resistant to wear - fan will remain efficient longer than axial fans.

Flexible Joint & Skid
Ease of installation, removal and maintenance.

Howden
A Chart Industries Company

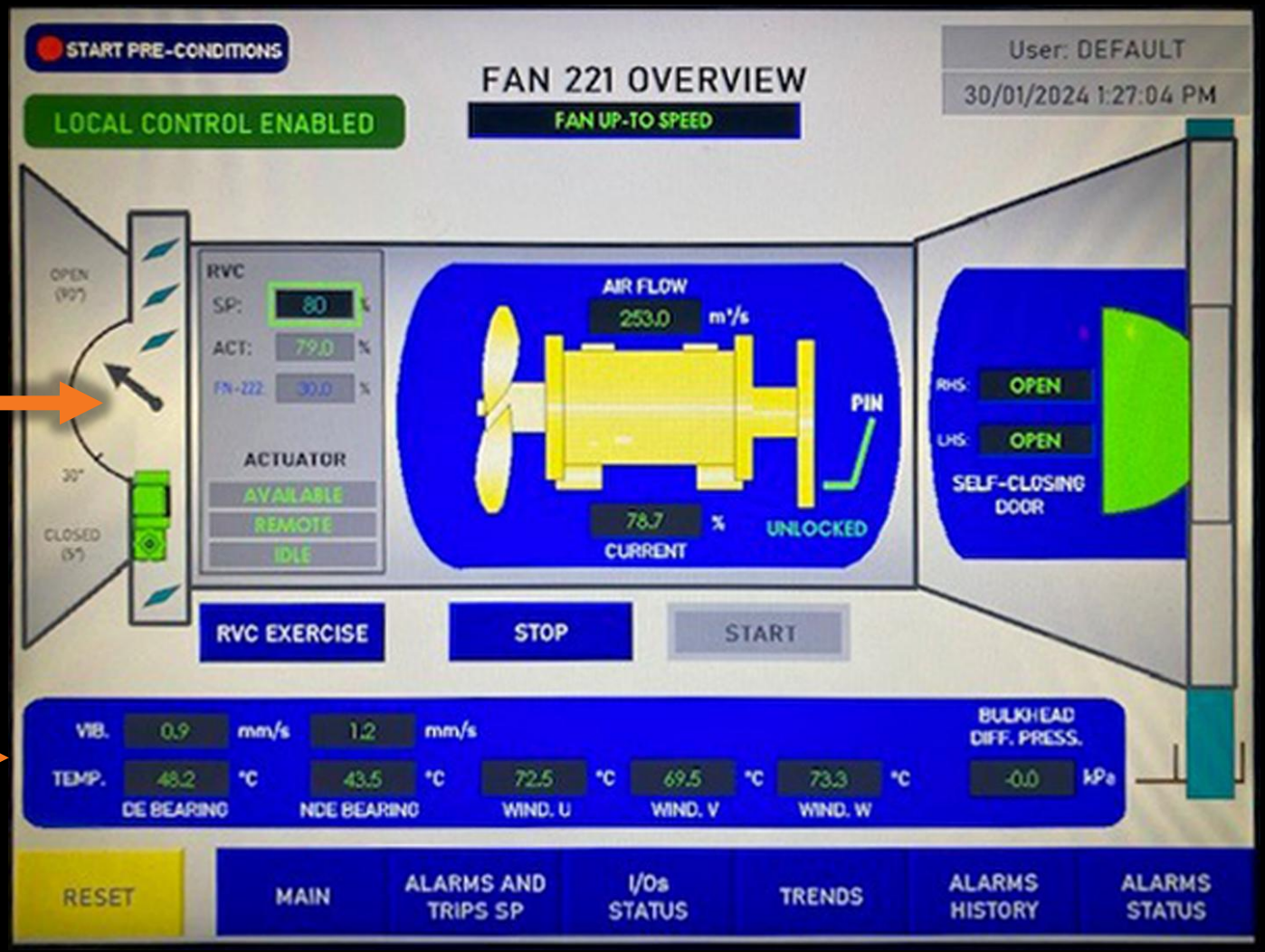
Quick Facts
2625mm diameter
8-pole
750 RPM
15 blades

© 2026 Chart Industries, Inc. Confidential and Proprietary

Electrical Control System & VOD Integration

Inlet Radial Vane Control (RVC)

Field Instruments



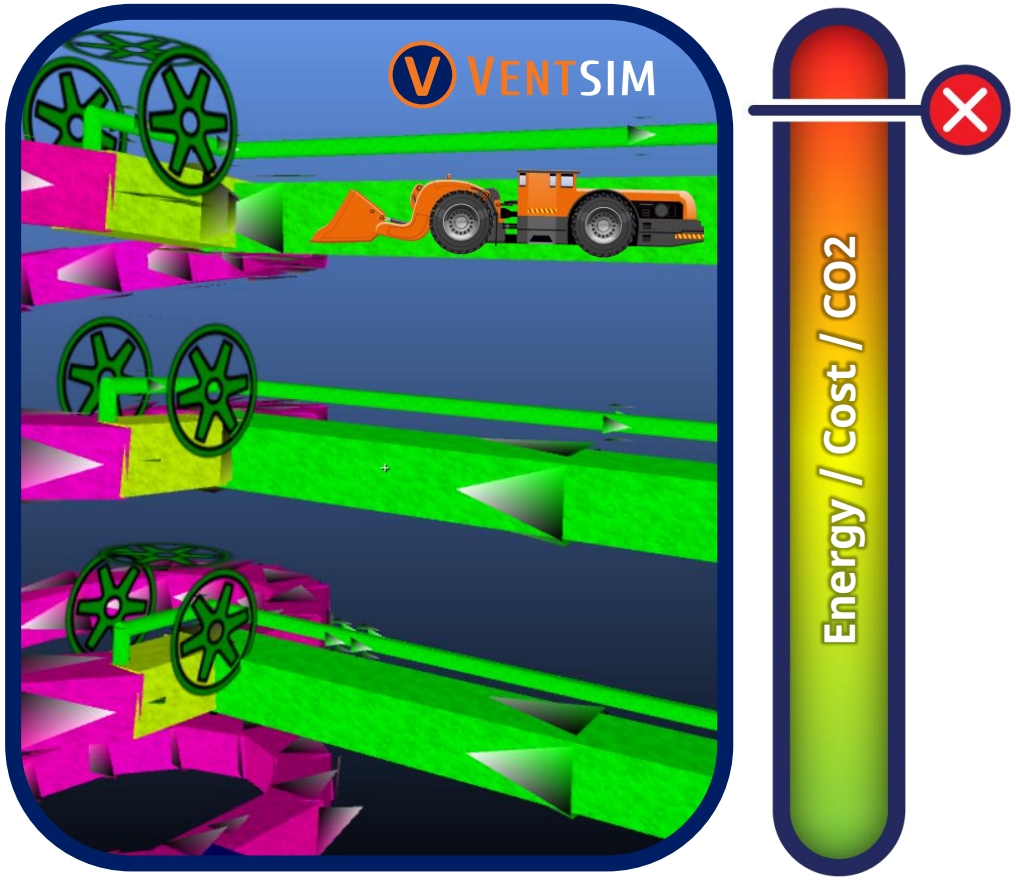
Programmable Logic Controller (PLC)

© 2026 Chart Industries, Inc. Confidential and Proprietary

Intelligent Control: Responsive Ventilation

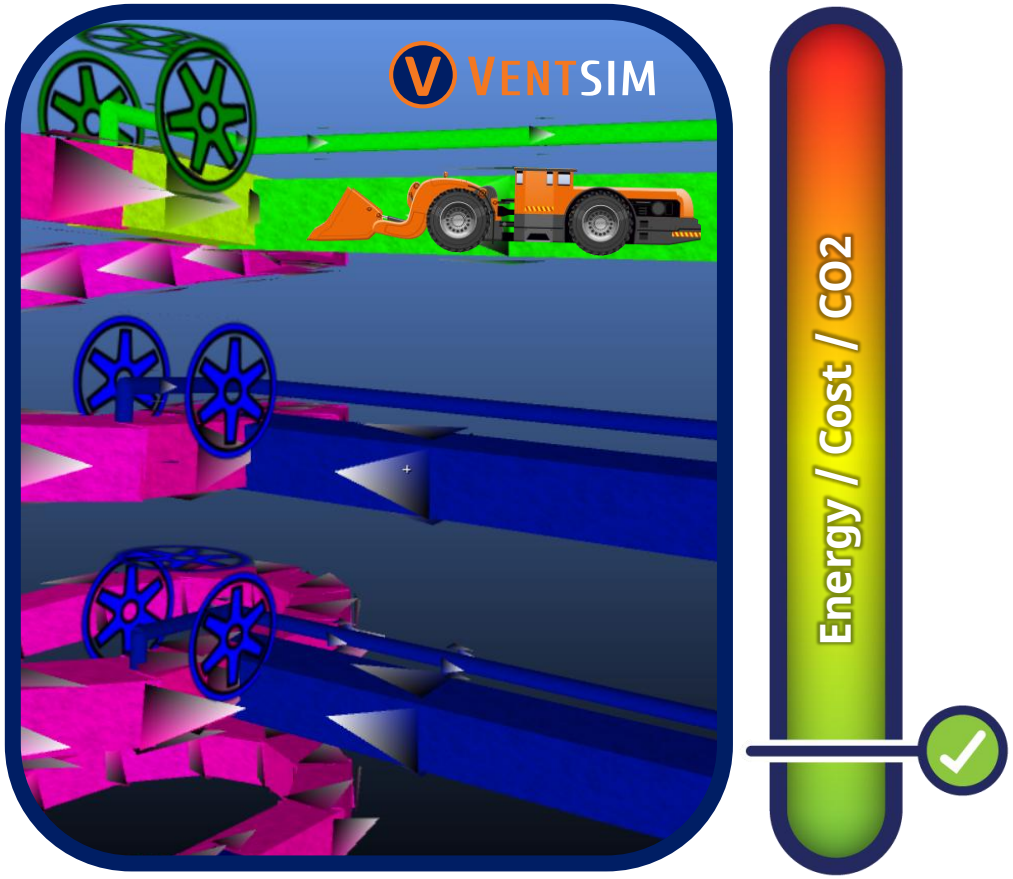
Common Mine Scenario

Fans run continuously whether needed or not.



Solution

The entire ventilation system should respond to demand.



© 2026 Chart Industries, Inc. Confidential and Proprietary

Fan Laws and How They Apply

Small reductions in airflow deliver disproportionately large power savings.

Fan Laws

FLOW

Flow ∝ Speed

A direct, linear relationship

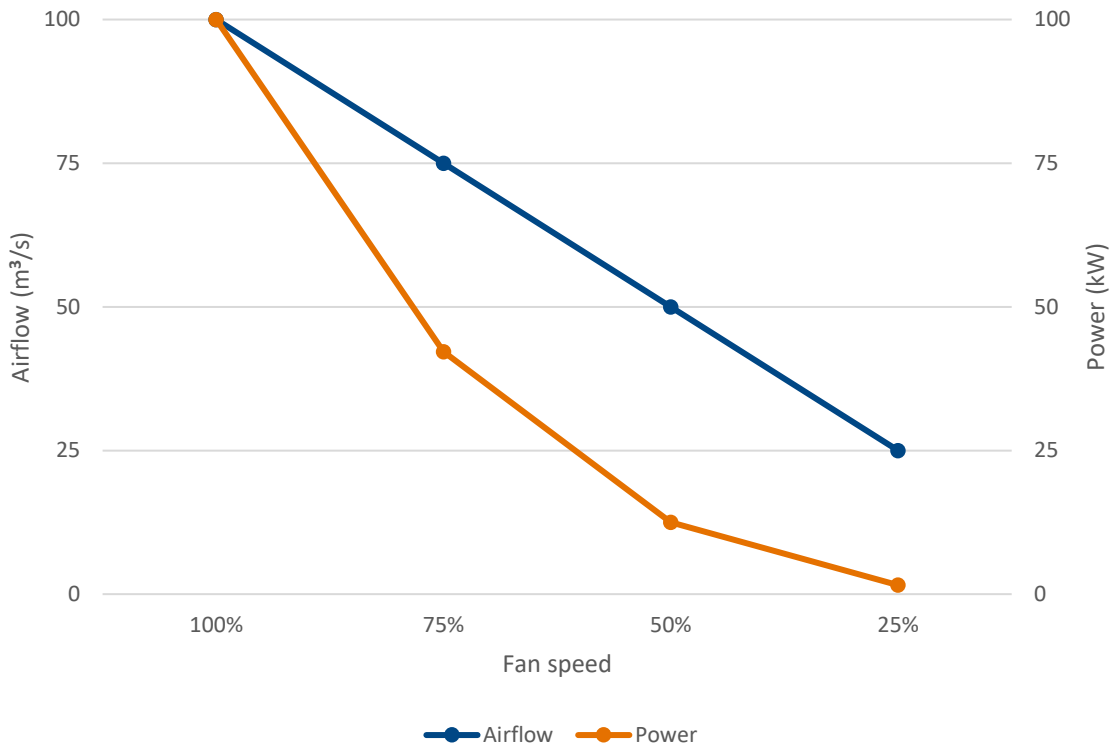
POWER

Power ∝ Flow³

Power falls much faster than airflow

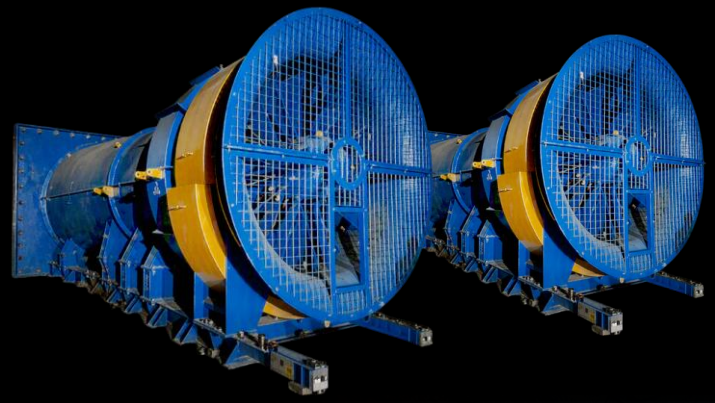
A 50% airflow setting requires only ~13% power.

Airflow vs Power for Different Fan Speeds



© 2026 Chart Industries, Inc. Confidential and Proprietary

What Ventsim CONTROL Does





Ventsim CONTROL
software continuously calculates air demand and communicates necessary fan and regulator setpoints

PLCs or remote I/Os enable remote control of fans, starters, VFDs and actuators

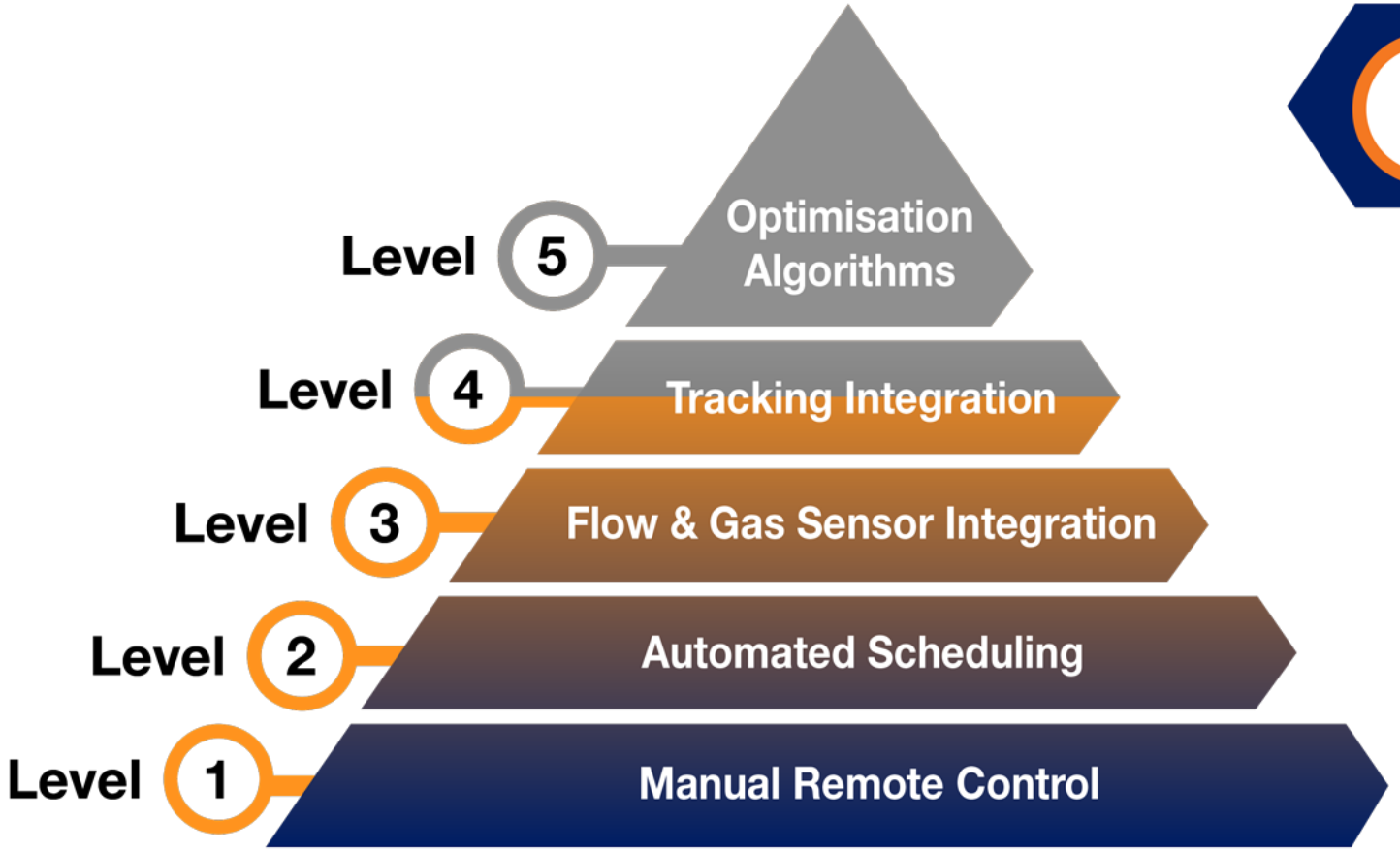


Vehicle position, airflow and gas sensor data are communicated to **Ventsim CONTROL**



© 2026 Chart Industries, Inc. Confidential and Proprietary

Implementation



Customisable and Versatile

Ventsim believes every mine and project are unique in their challenges and operations. With this understanding, we work with you no matter the level, to achieve your goals.

Implementing

Operating since 2024

Ventsim CONTROL: 5 Levels of Control

© 2026 Chart Industries, Inc. Confidential and Proprietary

The Proof, in Four Simple Numbers

3 HRS

saved on re-entry after a non-typical blast event



24/7

live monitoring with automated safety alarms



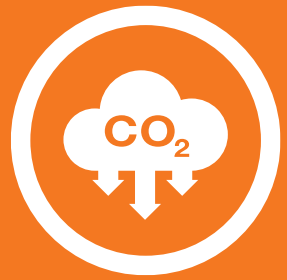
$1M+

saved in electricity costs in the first 4 months



39%

lower electricity use, a direct cut in CO2 emissions



One mine. One partnership with Howden and Ventsim. Real numbers.

© 2026 Chart Industries, Inc. Confidential and Proprietary

Conclusion: Sustainable Ventilation is Possible

Sustainable and safe ventilation

is not a single product;

it is the **combination of engineered equipment, automation, data visibility and operational discipline.**



© 2026 Chart Industries, Inc. Confidential and Proprietary

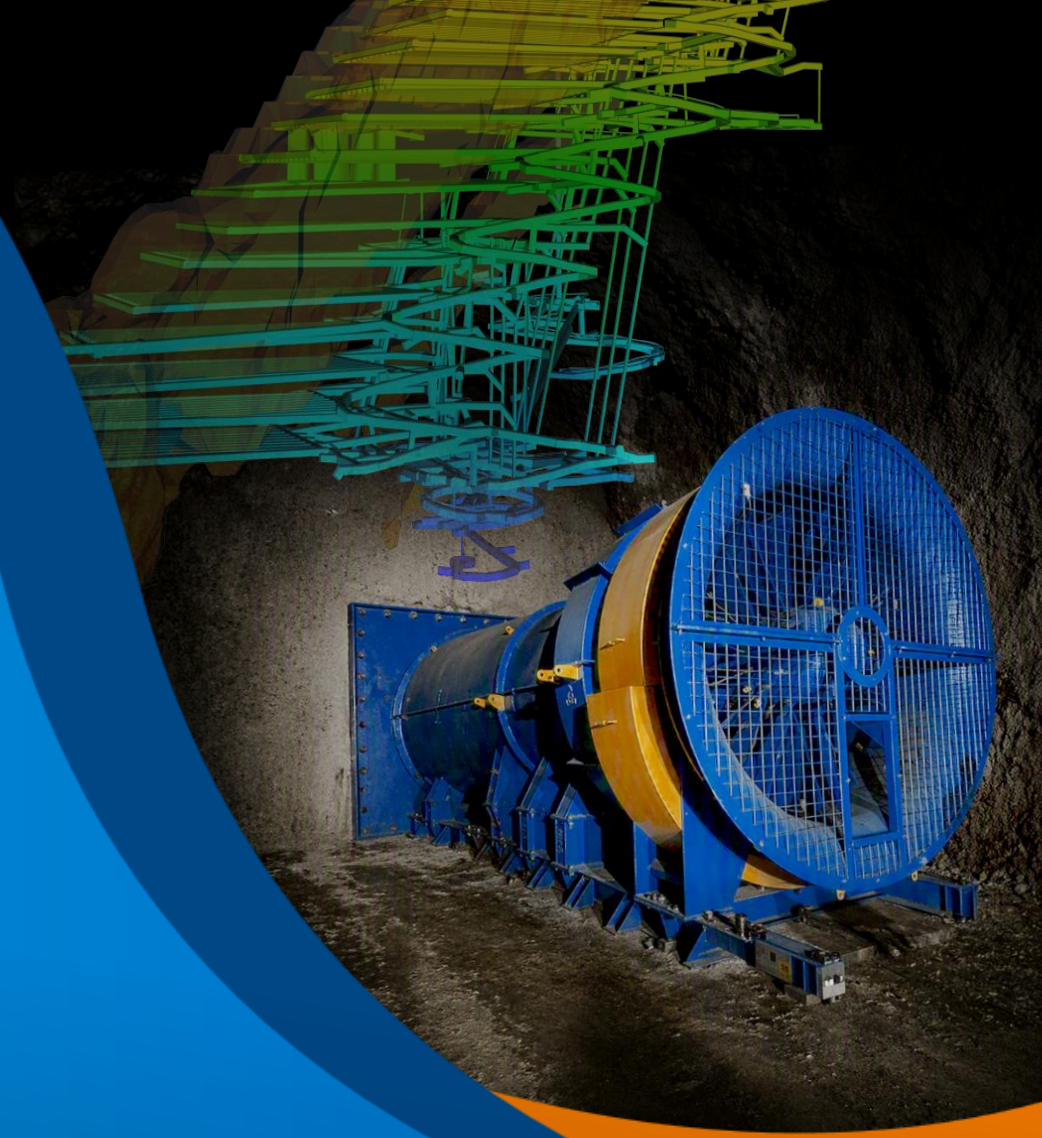
CHART
Cooler By Design ®

Howden
A Chart Industries Company

www.chartindustries.com

VENTSIM

www.ventsim.com



© 2026 Chart Industries, Inc. Confidential and Proprietary