

Integrating Energy Based Safety with critical control management in mining

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2026

Four metres is twice the energy that reliably kills.

- The bowtie says this matters.
- The energy says why, and how little margin there is.



You have Bowties & Critical Controls, and....

- We spend our time on the hardware.
- The energy is what kills.
- Do you know how much energy is present?
- Do you know which critical controls stop the flow of energy?



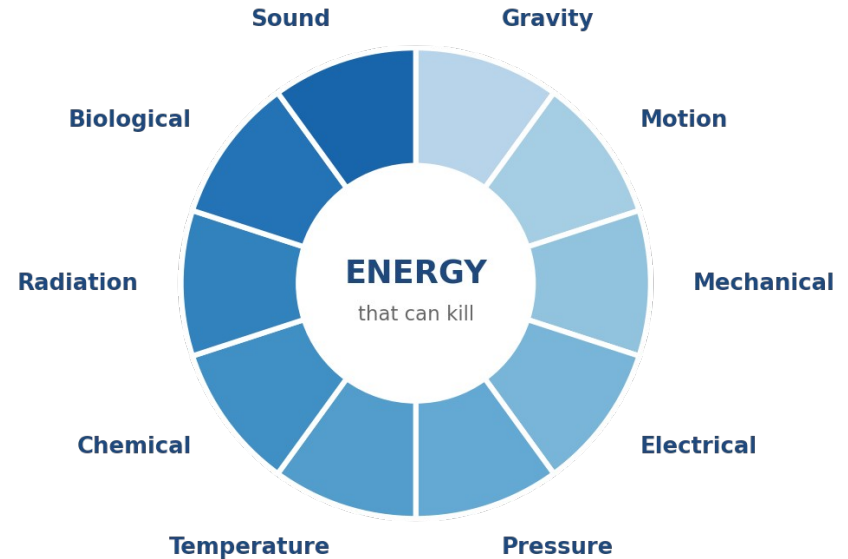
Twenty-plus operations. Twenty-five years at the bowtie.

Impress Solutions: critical risk management across coal, metalliferous, quarry and energy.



Energy Based Safety asks one question: where is the energy that can kill?

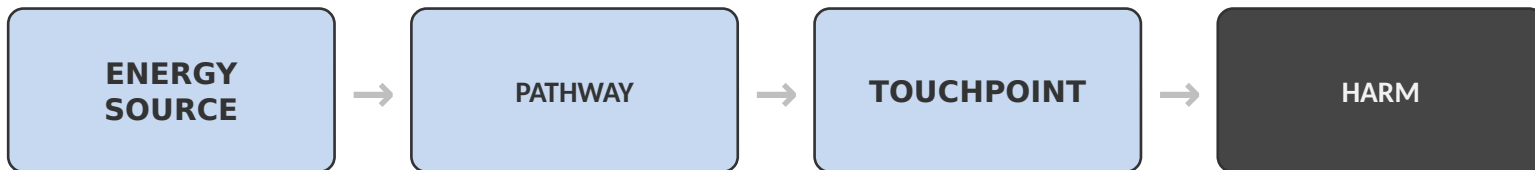
- Ten energy types, mapped on the energy wheel.
- A measurable lethal threshold — about 1,500 joules.
- Controls that act on the energy source, not on behaviour.



Critical Control Management & Energy Based Safety agree: the transfer of energy.

A source of energy reaches an asset by a pathway; a human action at a touchpoint releases it.

- Three opportunities follow — identify with the threshold, control with direct controls, equip the frontline with the wheel.



Opportunity 1 — The 1,500 joule threshold identifies fatal hazards

- Set a measurable line for lethal energy — about 1,500 joules.
- Above the line, the hazard can kill. That is an objective test, not a judgement call.

Opportunity 1 — In practice

- Run the risk assessment with an energy column and a high-energy flag on every row.
- A four-metre fall carries about 3,000 joules — twice the lethal line, flagged objectively.
- A 220 t haul truck at 40 km/h: tens of millions of joules.

Description of Unwanted Event	Release Mechanism / Scenario	Magnitude of Energy (EBS)	Hazard Classification (Energy Wheel)	Max Consequence (no controls)	Material Unwanted Event (Y/N)
Loss of control of surface mobile equipment	Brake or steering failure; operator fatigue/microsleep; loss of traction on a wet/steep grade; overspeed on descent; runaway on a ramp; loss of control of an autonomous/assisted function	A 220 t haul truck at 40 km/h carries tens of millions of joules of kinetic energy; a rollover, impact or fall into a void releases energy far above human tolerance (>>1,500 J)	Mechanical	5: Critical	Yes
Tyre and rim failure / explosion	Zipper failure; pyrolysis / thermal runaway; rim component separation during inflation or heat	A large earthmover tyre (e.g. 63-inch) holds roughly 2-3 m ³ of air at ~650-700 kPa; the stored pneumatic energy is of the order of 1-2 MJ (about 0.3-0.5 kg of TNT equivalent), released explosively with rim/lock-ring fragments on a zipper or rim failure — thousands of times the ~1,500 J threshold, before adding the thermal energy of pyrolysis.	Pressure	5: Critical	Yes
Highwall / lowwall / dump slope failure (ground failure)	Geotechnical instability; batter or tip-head collapse; dump-edge failure; burial or engulfment	Gravitational potential energy of the failed mass (E = mgh). Even a small failure of ~100 m ³ of rock (~250 t) with a centre-of-mass drop of ~10 m releases ~25 MJ; larger highwall or dump-edge failures reach hundreds of MJ to several GJ — tens of thousands of times the ~1,500 J threshold, with burial and engulfment fatal well below this.	Gravity	5: Critical	Yes
Inrush / inundation	Pit flooding; breach of old workings or a water source; failure of a water dam or low-density material	InundationThe energy of a large moving water or slurry mass. About 1,000 m ³ (~1,000 t) released down a ~10 m head holds ~100 MJ of potential energy (mgh); even a fast-moving 10 m ³ slug at 5 m/s carries ~0.1 MJ — orders of magnitude above the ~1,500 J threshold, with drowning and engulfment requiring only a fraction of it.	Gravity	5: Critical	Yes
Explosives — unplanned initiation or flyrock	Stray current / static; misfire handling; exclusion breach during firing	Chemical energy of the explosive. Bulk explosive (ANFO) releases ~3.9 MJ per kg, so a single blasthole of tens to hundreds of kg liberates hundreds of MJ on unplanned initiation. Even flyrock is high-energy — a 5 kg fragment at 30 m/s carries ~2,250 J — above the ~1,500 J threshold.	Chemical	5: Critical	Yes

Opportunity 2 — Direct controls give 'critical' a physical basis

- 1 Targeted** at the lethal energy
- 2 Effective** when properly installed and used
- 3 Holds under error** works even when the worker makes a mistake

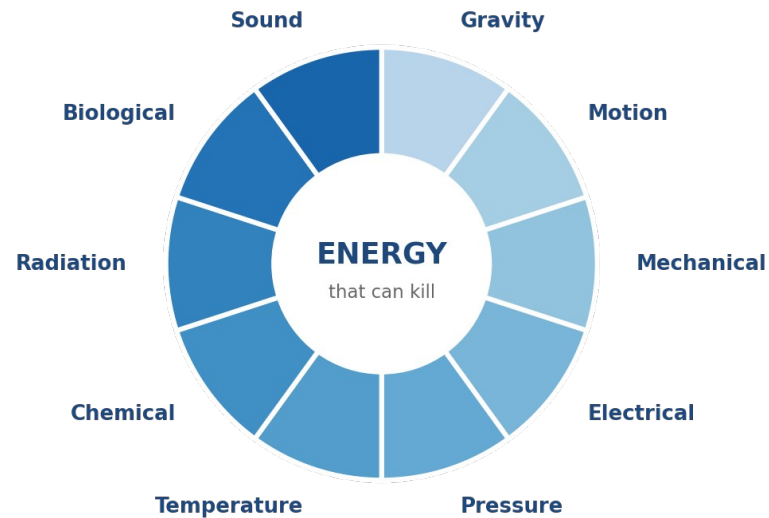
**All three.
In or out.**

Opportunity 2 — Direct vs non-direct controls

- Direct controls act on the energy and hold even if the worker errs:
- E.g. permanent guardrail; hard barricade; interlock; passive fall protection.
- Non-direct controls depend on the worker getting it right:
- E.g. a harness that relies on clipping on; training; signage; a spotter.
- For our four-metre fall: the guardrail is direct; the harness is not.

Opportunity 3 — The energy wheel equips the frontline

- Ten energy sources on one simple wheel.
- Unaided, teams see about half the hazards; the wheel surfaces the lethal ones.



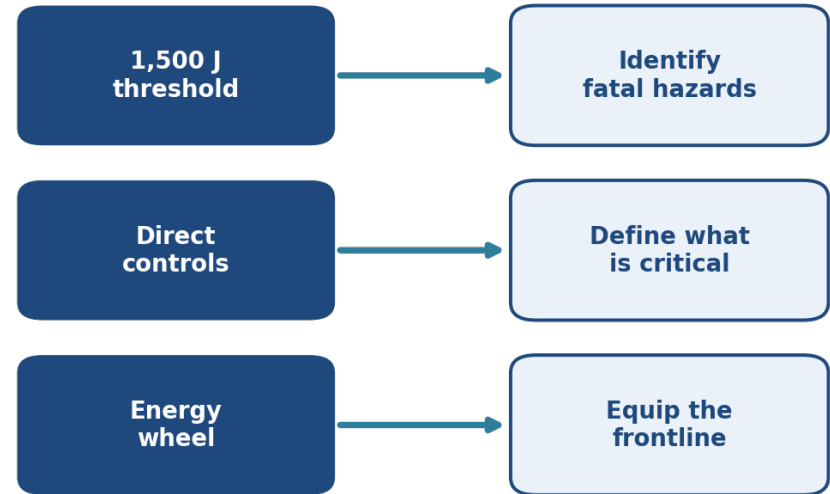
Opportunity 3 — In practice: pre-starts and the point of work

- Scan the task against the energy wheel in the pre-start or take-5.
- Name the energy: 'you're four metres up — about 3,000 joules, twice what kills — and this guardrail holds it.'



One integrated method, mapped stage by stage.

- 1,500 J threshold → identify fatal hazards.
- Direct controls → define what is critical.
- Energy wheel → equip the frontline.



Test your program through an energy lens

- Do you know the lethal energy on your highest risks?
- Do your critical controls act on the energy source — and hold if the worker errs?
- Can your frontline name the energy their control holds?

What if every fatal risk was seen through energy?

Run Energy Based Safety and critical control management as one method, not two.



There's more here than fifteen minutes allows.

The full integration goes deeper than we can today - take the one-page version with you, and if you want to talk it through, the door's open.



Free energy wheel + integration
sheet (scan)



Want to talk it through? Book a
call (scan)

Questions

Let's find the energy that can kill and keep saving lives at work.



Free energy wheel + integration
sheet (scan)



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