

ENERGY-BASED SAFETY APPLICATION IN THE CARIBBEAN: PROTECTING WORKERS, BUILDING RESILIENCE

1.0 Introduction

The Caribbean is home to diverse industries where high-energy hazards are ever-present. From construction sites and oil refineries to utilities and process operations, workers routinely interact with high energy hazards such as electrical, mechanical, chemical, gravitational, thermal among others, that, if left uncontrolled, can cause **serious injuries or fatalities (SIFs)**. **SIFs are life-ending, life-threatening and life- altering events.**

SIF risks are not confined to routine operations; they escalate significantly during post-disaster restoration and reconstruction following hurricanes, floods, earthquakes, or volcanic eruptions. In such contexts, the urgency to rebuild and restore critical infrastructures often collides with heightened exposure to high energy hazards, creating conditions where traditional safety programs may fall short.

Recent advances in occupational safety research, particularly **Matthew R. Hallowell’s Energy-Based Safety: A Scientific Approach to Preventing Serious Injuries and Fatalities (2025)**, provide a scientific framework to better understand and control these risks for us in the Caribbean.

Drawing on principles of energy-based safety research as set out in Hallowell's book and our Caribbean experiences, this article highlights the importance of applying energy-based safety principles in protecting workers and strengthen resilience. Industries in the region that adopt these practices naturally will improve their capacity to prevent serious injuries and fatalities (SIFs), while remaining productive in the face of recurring natural disasters.

2.0 High-Energy Hazard Industries in the Caribbean

Caribbean Industries where high-energy hazards are most prevalent include but is not limited to:

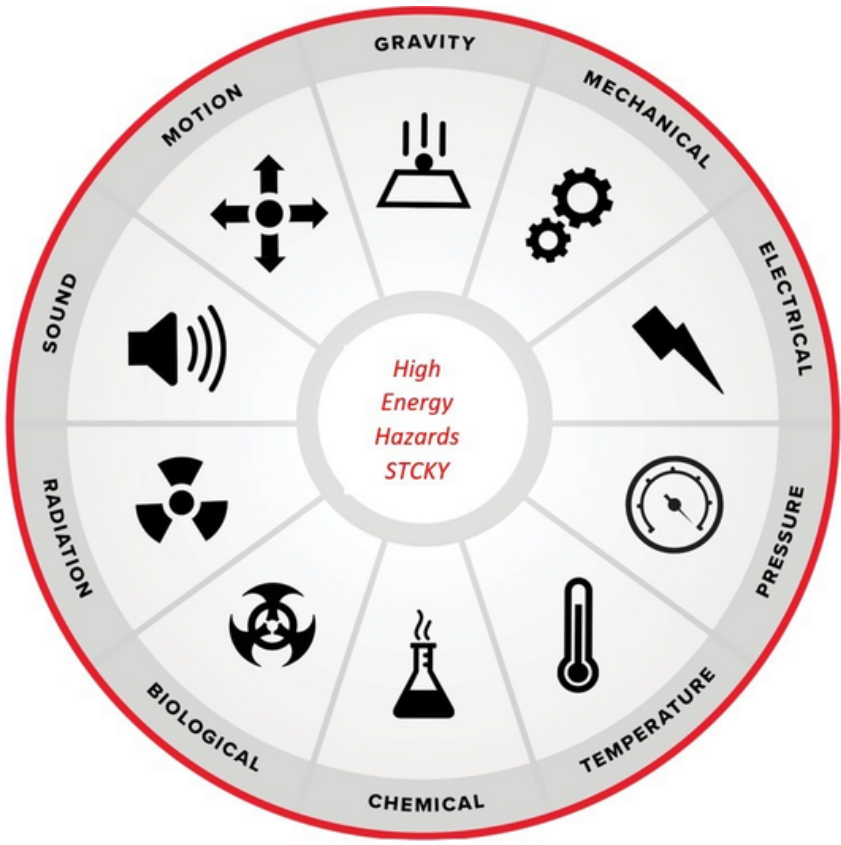
- Construction
- Mining and mineral processing operations
- Oil drilling, abstraction, and refinery processes
- Maintenance of water and telecommunication utility services
- Power generation, transmission, and distribution operations
- Distillery operations
- Manufacturing operations

These sectors demand better energy source hazard identification and control measures under normal operating conditions, and even greater vigilance during disaster recovery efforts.

3.0 Understanding Energy Hazards

Energy is a powerful force that can cause harm if not properly controlled. Using the **energy wheel (see figure#2)**, Caribbean organizations can identify all types of hazardous energy sources—mechanical, electrical, thermal, chemical, gravitational, and more and do a better job in applying energy-based controls rooted in the following **Key principles**:

- **More energy causes more harm:** The higher the magnitude of energy, the greater the potential for severe injury.
- **Prioritize the Stuff That Can Kill You (STCKY) hazards:** Focus on **STCKY** that is high-energy hazards that pose the greatest risk.
- **Controls save lives:** Controlling the STCKY using direct and alternative controls
- **People drive performance:** Context matters—leaders and workers must understand how energy controls function in their environment.



Figure#1: Energy Wheel Adapted from Quanta

4.0 Characteristics of Effective Energy Controls

Energy controls are **physical measures** that actively reduce or remove hazardous energy. To be effective, they must meet the 3Ts:

- **Timely:** In place and functioning during the work activity when the high energy hazard is present. This ensures the control is used exactly when the risk exists
- **Tangible:** Physically present and observable on the jobsite. Something that the workers can see, interact with or verify rather than a paper based or administrative measure
- **Targeted:** Specifically designed and installed to address the identified high energy hazard.

Examples of energy controls include:

- Traffic control wardens in utility or construction zones
- Spotters for reversing vehicles or lifting operations
- Proximity detection systems
- Cones, signage, and caution tape
- Machine guarding
- Permanent guardrails at height
- Arc flash-rated PPE
- Fall protection systems
- Load-limiting devices on cranes
- De-energization and Lockout/Tagout
- Verification of the absence of energy
- Temporary protective grounding

5.0 Direct Controls

Direct controls are the highest standard for preventing serious injuries or fatalities. They mitigate hazardous energy at its source through:

- **Elimination:** Removing the energy source entirely.
- **Reduction:** Lowering energy magnitude to safe levels.
- **Isolation:** Shielding workers with physical barriers.

In addition to meeting the 3Ts, Direct controls must effectively mitigate exposure to the high energy hazard when installed, verified and used properly and remain reliable even if human error occurs. Examples of direct controls include:

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- Machine guarding
- Permanent guardrails
- Arc flash PPE
- Fall protection systems
- Load-limiting devices on cranes
- De-Energize and Lockout/tagout
- Test for the Absence of Voltage and applying temporary Protective Grounding

Research shows that even among industry leading companies only **65–75% of high-energy hazards have direct controls based on the definition criteria (Hallowell, 2025, p. 54)**

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6.0 Alternative Controls

When direct controls are not feasible, **alternative controls** must be applied. These are not standalone solutions but require **two complementary and independent methods of error reduction**, each meeting the timely, tangible, and targeted criteria.

Categories of alternative controls:

- **Physical obstacles:** Non-engineered barricades such as cones or toppers.
- **Dedicated monitoring:** Continuous attention from a spotter, attendant, or detection system.
- **Visual reminders:** Specialized signage, e.g., speed limits in construction zones.

Examples of alternative controls include:

- Traffic control wardens
- Spotters for reversing or rigging operations
- Proximity detection systems
- Cones, utility work signs, and caution tape

7.0 Hierarchy of Energy Control

Not all controls are equal. The **hierarchy of energy control** provides a structured approach:

- 1.**Energy elimination**
- 2.**Energy reduction**
- 3.**Energy isolation**
- 4.**Alternative controls**

This hierarchy ensures that the most effective measures are prioritized, reducing reliance on weaker safeguards.

8.0 Conclusion

Managing high-energy hazards in Caribbean industries requires a disciplined approach rooted in direct controls, supported by alternative controls when necessary. By prioritizing STCKY hazards, applying timely, tangible, and targeted controls, and reinforcing worker awareness that safety is the presence of safeguards and not simply the absence of injuries, Caribbean organizations can significantly reduce the risk of serious injuries or fatalities (SIFs). Whether during routine operations or post-disaster recovery, the principle remains clear: controls save lives, and people drive performance.