Energy Wheel & Process Safety

Connecting hazardous energy control to design, operations, and maintenance

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Objectives

By the end of this session, participants should be able to:



Explain the relationship

Between the Energy Wheel and Process Safety



Understand the link to incidents

How hazardous energy relates to major incidents



Apply Energy Wheel concepts

Across Design, Operations, and Maintenance



Recognize barrier thinking

How the Energy Wheel supports risk management

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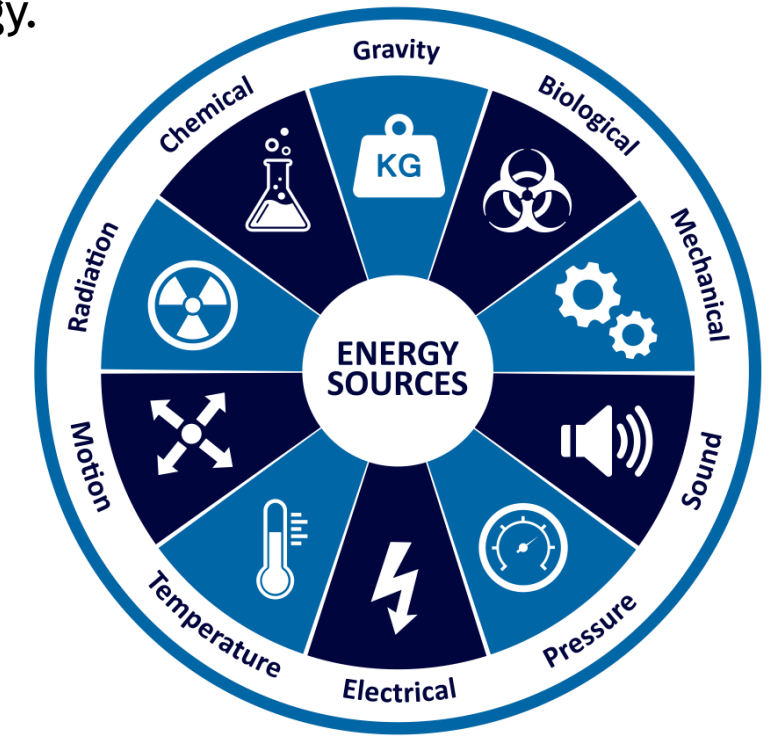
What is the Energy Wheel?

The Energy Wheel

The Energy Wheel is a hazard recognition tool adopted by Energy Safety Canada to help workers identify and control hazardous energy.

Purpose

- Improve hazard recognition
- Identify multiple energy sources
- Support safer work processes
- Reduce serious incidents and fatalities



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What is Process Safety?

Process Safety focuses on preventing:

- Loss of containment
- Fires and explosions
- Toxic releases
- Overpressure events
- Equipment failures
- Catastrophic incidents

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Process Safety is different from Personal Safety

Personal Safety	Process Safety
Slips/trips/falls	Major incident prevention
Individual injuries	Multiple fatalities / assets / environment
PPE focused	System and barrier focused
High likelihood, low consequence	Low likelihood, high consequence

What is Process Safety?

Why they're closely connected

Process Safety is about controlling hazardous energy. Major incidents usually involve uncontrolled energy release:



Bottom line: Every major incident traces back to at least one uncontrolled energy source.

The Energy Wheel helps teams

- Recognize energy hazards
- Identify stored / residual energy
- Understand energy interactions
- Verify safeguards and barriers
- Improve pre-job planning

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Hazard recognition and blind spots

Improving hazard recognition

Many serious incidents occur because hazards were not fully recognized.

Common Examples

- Electrical isolation completed but stored pressure remains
- Hot work performed near flammable vapors
- Suspended loads overlooked during SIMOPS
- Residual chemical hazards not identified

The Energy Wheel helps prevent:

- Tunnel vision
- Incomplete hazard assessments
- Single-hazard thinking
- Barrier failures

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Barrier thinking in Process Safety

Barrier and safeguard thinking

Modern Process Safety relies on barriers and safeguards.

Key Questions

- What energy exists?
- What controls the energy?
- What happens when controls fail?
- Is there stored or residual energy?

Typical safeguards

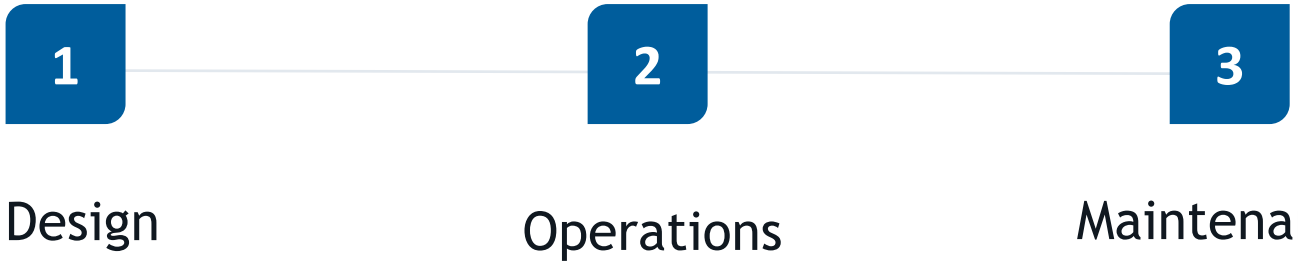
- Relief valves
- Isolation valves
- Lockout/tagout
- Fire and gas detection systems
- Alarms and shutdowns
- Procedures and permits

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Lifecycle Integration

Applying the Energy Wheel across the lifecycle

The Energy Wheel supports Process Safety throughout:



Goal

Maintain control of hazardous energy at all times

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1 Design Phase

Energy Wheel in design

Supports:

- HAZID
- HAZOP
- Inherently Safer Design
- Design Reviews
- Safeguard Selection
- Human Factors Reviews

Design questions

- Could overpressure occur?
- Are ignition sources present?
- Could gravity or motion create hazards?
- What happens during equipment failure?

Design examples

Pressure Energy

Drives:

- Pressure relief systems
- Blowdown systems
- Emergency shutdown systems

Chemical/Thermal Energy

Drives:

- Material compatibility
- Fireproofing
- Ventilation
- Separation distances

Gravity and Motion Energy

Drive:

- Structural supports
- Safe access
- Lifting plans
- Equipment spacing

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2 Operations Phase

Energy Wheel in operations

Supports:

- Pre-job hazard assessments
- Toolbox talks
- Permit-to-work systems
- SIMOPS planning
- Shift handovers
- Abnormal operations management
- Critical barrier management
- Critical bypass management

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Operational focus

- Maintaining barrier integrity
- Controlling live energy sources
- Preventing unintended releases

SIMOPS example

SIMOPS and hazardous energy Example Scenario

Simultaneous:

- Maintenance work
- Crane activity
- Hot work
- Live production operations

Key Lesson: SIMOPS failures often result from unmanaged overlapping energies.

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Potential Energy Interactions


Pressure: Hydrocarbon release


Electrical: Temporary power systems


Thermal: Hot work ignition


Motion: Mobile equipment/wellhead



Gravity: Dropped object on live vessel


Chemical: SO2 exposure/fall hazard

3 Maintenance Phase

Energy Wheel in maintenance

Supports:

- Lockout/tagout
- Isolation planning
- Equipment opening
- Confined space entry
- Stored energy management
- Mechanical integrity activities
- Management of Change

Maintenance Risk:

Barriers are often temporarily defeated during maintenance.

Maintenance example

Pump Repair

Before maintenance begins, teams must consider:

- Electrical energy
- Stored spring tension
- Residual pressure
- Chemical exposure
- Rotational energy
- Thermal energy

Critical Questions: “Have ALL energy sources been isolated and verified?”

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Mechanical Integrity and Process Safety

Process Safety depends on maintaining equipment integrity.

Critical Equipment

- Pressure vessels
- Piping systems
- Relief devices
- Instrumentation
- Rotating equipment
- Isolation valves

Energy Wheel Contribution

Encourages teams to think about:

- Failure consequences
- Energy release potential
- Safeguard effectiveness

Human Performance and Culture

Human Performance Connection

The Energy Wheel supports:

- Situational awareness
- Critical thinking
- Verification practices
- Effective communication
- Risk awareness
- Operational discipline

Strong Safety Culture Requires:

- Hazard recognition
- Respect for energy
- Consistent safeguards
- Learning mindset

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Key Takeaways

The Energy Wheel:

- Is a practical hazard recognition tool
- Supports Process Safety principles
- Helps identify hazardous energy systematically
- Strengthens barrier thinking
- Applies across design, operations, and maintenance

Most major incidents involve:

- Uncontrolled hazardous energy
- Failed safeguards
- Incomplete hazard recognition

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Conclusion

The Energy Wheel is not separate from Process Safety. It is a practical tool that helps:



Identify hazardous energy



Improve hazard recognition



Strengthen barriers



Support safe design



Improve operational discipline



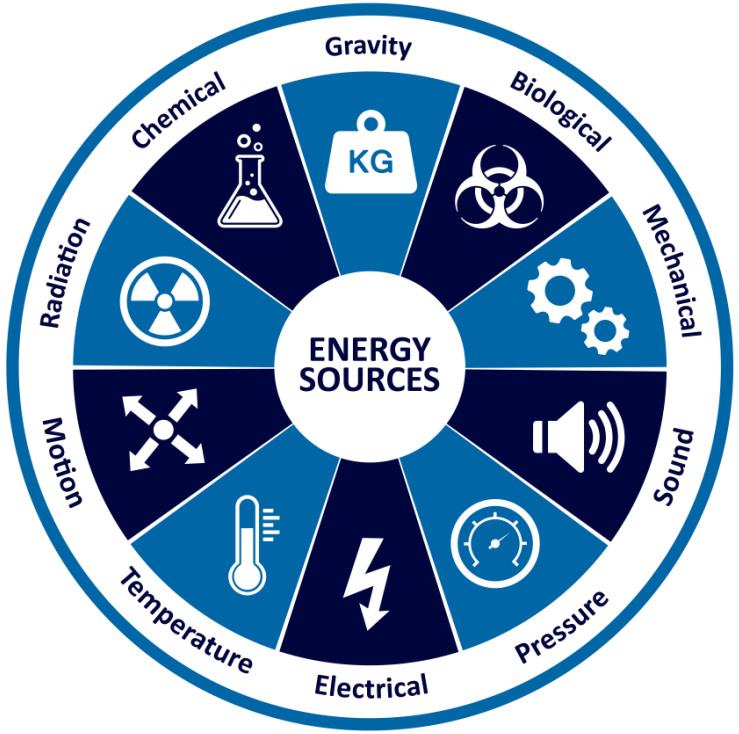
Protect people, assets, and the environment

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Reflection Questions

In your own organization:

- Where are we most likely to overlook hazardous energy?
- Which lifecycle phase provides the greatest opportunity to improve energy control?
- Where do we have the greatest potential for energy interactions?
- How effectively do we verify that our barriers are actually working?
- How could the Energy Wheel be incorporated into existing processes across the organization rather than treated as an additional requirement?



Practical Challenge

Look at your existing process safety and work-planning processes through the lens of hazardous energy.

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PROCESS SAFETY + ESC ENERGY WHEEL = SAFER OUTCOMES

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The Energy Wheel helps us see, understand and control all forms of hazardous energy — a core principle of Process Safety.

What is Process Safety?

Process Safety prevents high-consequence incidents by controlling hazardous energy and maintaining barriers, system integrity and safeguards.

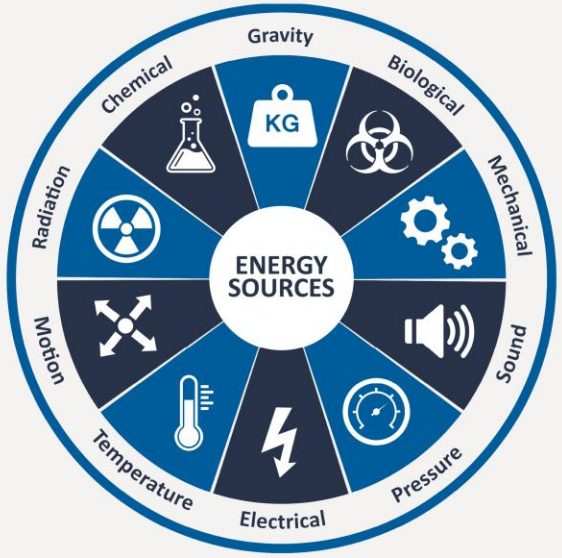
Process Safety focuses on preventing:

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Same Goal, Same Risk

Process Safety manages the system.

The Energy Wheel helps people recognize and control the energy that can cause a major incident.



Stronger Together

By combining Process Safety principles with the Energy Wheel, we improve hazard recognition, strengthen barrier thinking and reduce the risk of major incidents.

How the Energy Wheel Relates to Process Safety

- **Identifies all energy sources**
  Prevents tunnel vision and blind spots.
- **Supports barrier thinking**
  Connects hazards to the controls that keep energy contained.
- **Improves hazard recognition**
  Looks beyond the obvious.
- **Reinforces system integrity**
  Considers stored and residual energy.
- **Bridges personal and process safety**
  Links everyday work to high-consequence risk.

Lifecycle Integration

The Energy Wheel supports Process Safety across the entire asset lifecycle.

01 Design

- Hazard identification (HAZID/HAZOP)
- Inherently safer design
- Safeguard selection
- Human factors

Goal: Design out or control hazards early.

02 Operations

- Pre-job assessments
- Permit-to-work
- SIMOPS planning
- Abnormal operations

Goal: Maintain barrier integrity and control live energy sources.

03 Maintenance

- Lockout/tagout (LOTO)
- Isolation and verification
- Mechanical integrity
- Confined space entry

Goal: Safely isolate, verify and control energy when barriers are temporarily removed.

The Result

Safer People | **Protected Assets** | **A Healthier Environment**

Same principles. One goal. Prevent major incidents.

The Energy Wheel is a hazard recognition tool adopted by Energy Safety Canada (ESC) to help workers identify and control hazardous energy.

Process Safety Awareness Course

This awareness-level course introduces participants to the fundamentals of process safety. Participants will gain a broad understanding of key process safety principles and why they are important in preventing incidents.

Cost: $35

Process Safety | Program | Energy Safety Canada

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Thank you!

