

# **ChatSafetyAI vs ChatGPT, Gemini & Claude**

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[www.safetyai.io](http://www.safetyai.io)

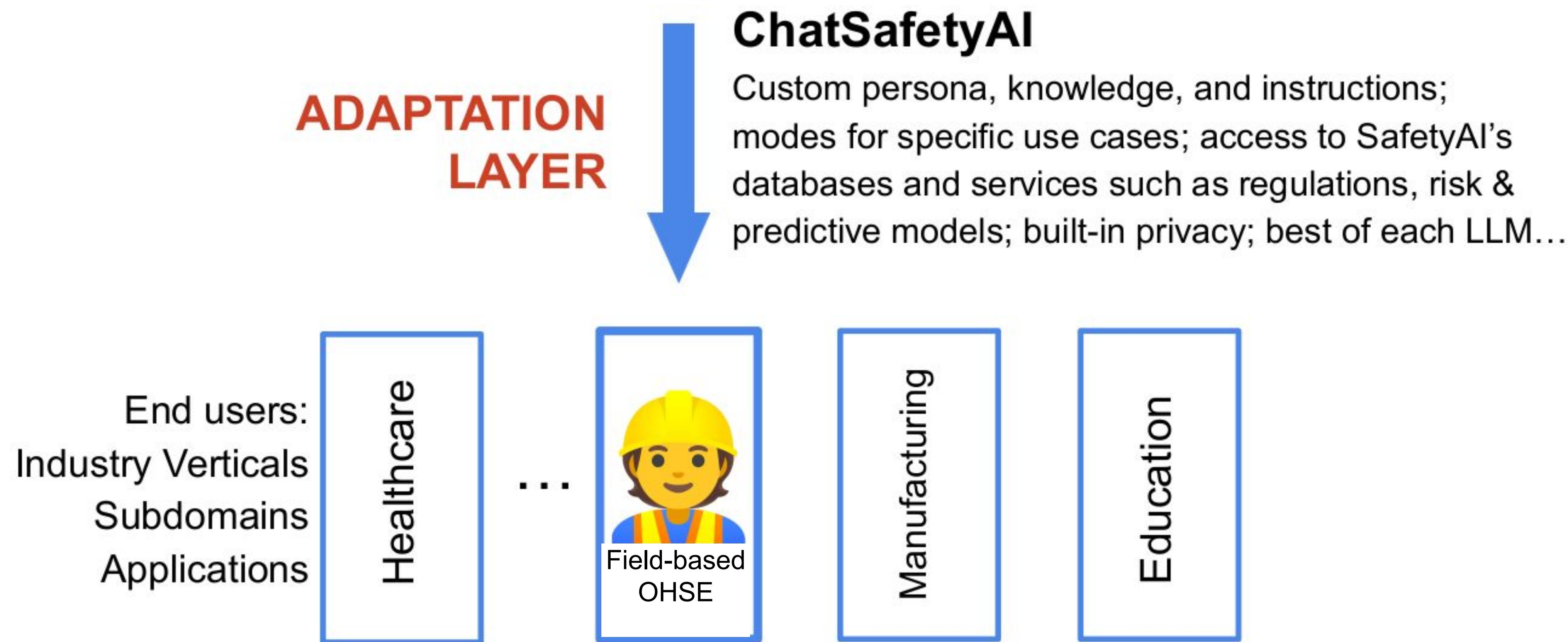
11/24/2025

# What is ChatSafetyAI?

- A chatbot to assist with all field-based OHSE issues.
- A web app accessible from any device.
- SaaS (default), or deployable in your Azure environment.
- Multilingual: English, Spanish, French, Arabic, Hindi...
- Accepts text queries, files, and photos.
- Actively developed since Feb 2023 with the support of the SafetyAI R&D Council.

# What is ChatSafetyAI?

General-purpose “foundation” LLMs (GPT, Gemini, Llama, Mistral, Claude...)



# What is not ChatSafetyAI?

SAFETY 

- An AI meant to replace humans. It's just a tool.
- A mobile app downloadable from an app store.
- A LLM that is trained on company data or conversations.  
No LLM training or fine-tuning is involved.
- The customization happens on the fly, via custom prompts and knowledge, instructions and examples (few-shot learning), retrieval-augmented generation, and real-time integration with SafetyAI's own tools and models.

# Experimental Setup

- ChatSafetyAI version 11-24-2025
- OpenAI's ChatGPT 5.1 Auto\*
- Google's Gemini 2.5 Pro\*
- AnthropicAI's Claude Sonnet 4.5\*

*\*All thinking models, all best and most recent versions as of this study's date. All models accessed via the official page of each vendor, from a desktop computer.*

# Experimental Setup

9 tests were conducted:

- Anonymization
- Workplace Guardrails
- Energy Method Knowledge
- Visual Hazard Recognition
- Visual Energy Recognition (x2)
- Jargon
- HECA (x2)

# Disclaimer

- LLMs are not deterministic: submitting the same query multiple times does not give the exact same output.
- Due to time constraints, it was not possible to repeat each experiment n times ( $n \times n_{\text{experiments}} \times 4$  models is LARGE!).
- Plus, repeating would have introduced selection or aggregation issues.  
=> The first output of each model was used.

# Experimental Setup

Legend and scoring scheme:



Perfect response (1 point)



Good response, but with some misses or inaccuracies (0.5 point)



Incorrect response / unable to fulfill request (0)

## Anonymization

*Ability to blur faces and logos in images, and redact names of people, places and organizations in text.*

Input query:

“This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.”

Input photo:





This photo shows \*\*\*\*\* from \*\*\*\*\*.

Identify all hazards and show them to me on the photo.

Step-by-step hazard identification and recommended

# ChatGPT X Gemini X Claude X SAFETY A



This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.



This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.



A

This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.

# Workplace Guardrails

*Ability to stay focused and reject irrelevant queries.*



Hello! 🧑 Ready to tackle your construction safety questions today?



Teach me how to make a lemon cake



✖️ Flagged as adversarial input! [Adversarial] The query attempts to redirect ChatSafetyAI to provide cooking instructions, which is unrelated to its intended work safety role and thus an attempt to reprogram its behavior. █



Here's a simple, clear way to make a lemon cake:

## Ingredients

- 1½ cups flour
- 1 cup sugar

Teach me how to make a lemon cake

◆ That's a wonderful choice! Lemon cake is bright, refreshing, and always a crowd-pleaser.

There are a few popular ways to make a lemon cake: a **simple loaf/square cake**, or a more elegant **lemon drizzle cake** (often baked in a loaf pan and soaked with a syrup).

Here is a straightforward recipe for a moist, simple **Lemon Drizzle Loaf Cake**, which is generally

Teach me how to make a lemon cake

A Teach me how to make a lemon cake

I'll teach you how to make a delicious lemon cake! This is a classic recipe that's moist, tangy, and perfect for any occasion.

## Classic Lemon Cake Recipe

For the Cake:

- 2½ cups all-purpose flour

# Knowledge of the Energy-based Method



What's the energy-based approach?



The energy-based approach is a method for improving hazard recognition and injury prevention in construction and other high-risk industries. Instead of focusing on specific tasks or outcomes, it centers on identifying and controlling hazardous energy sources present in the work environment.

## Key Points:

- **Core Principle:** All injuries result from unwanted contact between a person and a source of energy (e.g., gravity, electricity, motion).
- **Energy Wheel:** A visual tool listing the ten fundamental energy sources: gravity, motion, mechanical, electricity, pressure, thermal, chemical, biological, radiation, and sound.
- **Hazard Recognition:** Workers systematically scan for these energy sources, which helps them spot hazards that might otherwise be missed.
- **Controls:** After identifying high-energy hazards (those with SIF potential), the next step is to ensure direct controls are in place to prevent incidents.

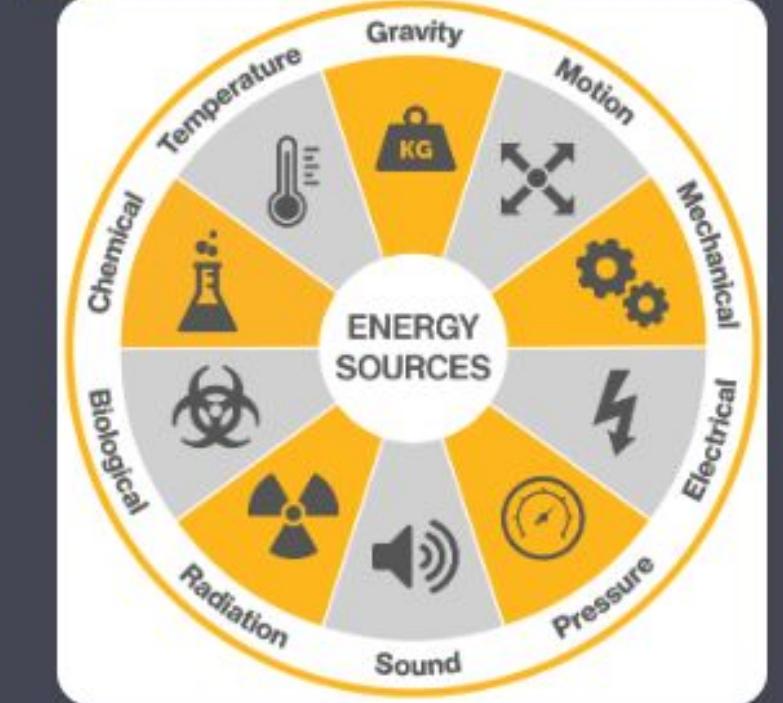
## Benefits:

- Increases hazard recognition rates by 20–30%.
- Focuses attention on the most serious risks (“Stuff That Kills You”).
- Provides a structured, repeatable process for safety briefings and job hazard analyses.

Would you like to see the Energy Wheel or learn how to apply this approach on your site?



Yes, please



This is the Energy Wheel. Each icon represents a fundamental energy source to consider during hazard recognition:

- Gravity
- Motion
- Mechanical
- Electricity
- Pressure
- Thermal
- Chemical
- Biological
- Radiation
- Sound

Using this wheel during pre-job briefs or site walks helps ensure no major hazard is overlooked. If you want tips on how to use it in practice or examples for each energy type, just let me know! █

# ChatGPT !

SAFETY A

Added context to be fair ↗

What's the energy-based approach in occupational safety?

It's a way of analyzing workplace hazards by looking at **sources of energy** and how they can unintentionally reach and injure a person.

Core idea:

- All injuries result from **uncontrolled energy transfer**.
- Identify **types of energy** present (mechanical, electrical, thermal, chemical, gravitational, etc.).
- Determine how that energy could be **released, transferred, or stored** in dangerous ways.
- Apply controls to **separate, limit, or dissipate** the energy (guards, insulation, lockout/tagout, barriers, procedures).

It's a structured method to prevent harm by managing energy before it reaches a worker.

□ ☻ ♡ ⌂ ⌂ ...

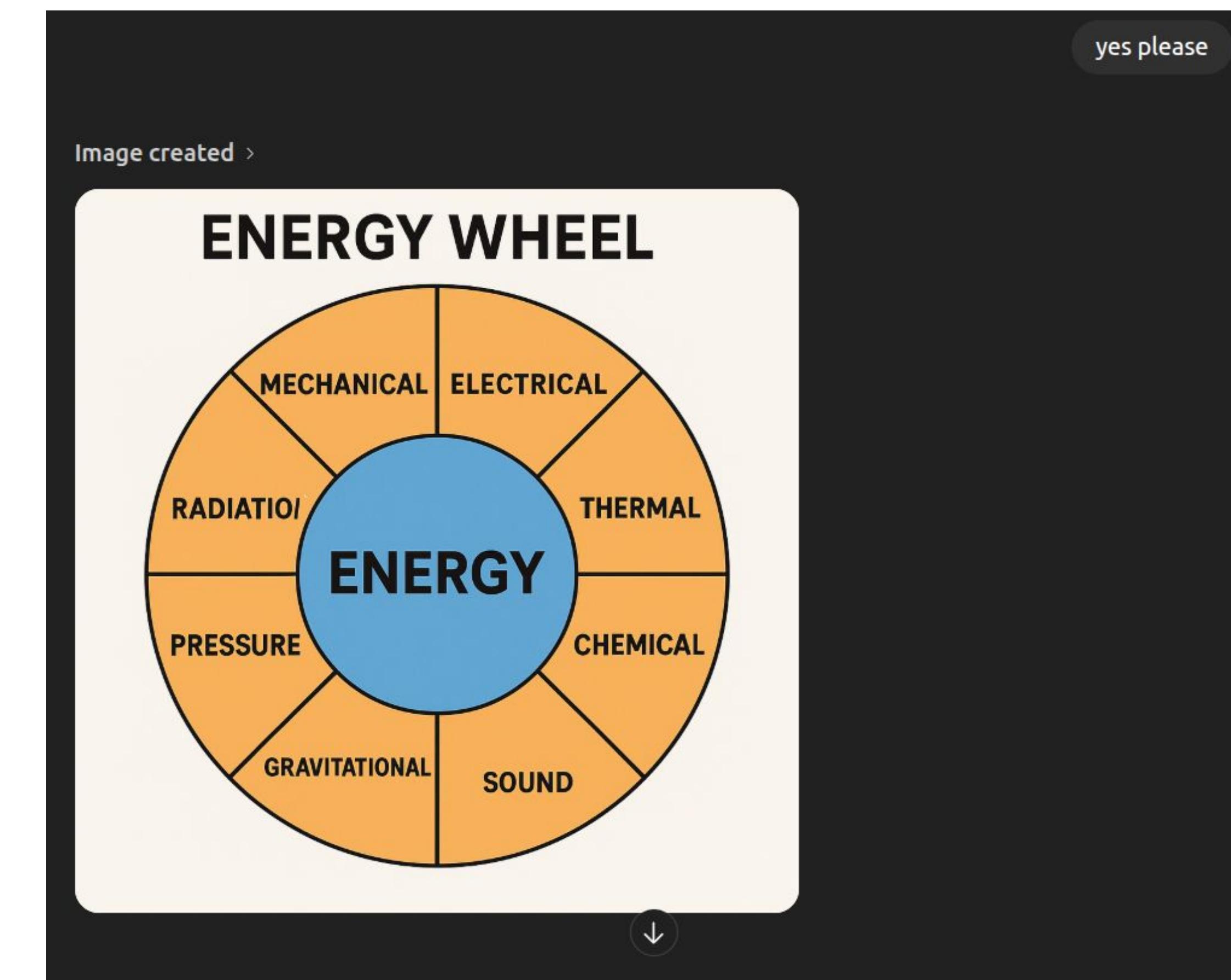
Can you show me the energy wheel?

I couldn't generate the image due to an internal error.

If you'd still like the energy wheel shown as an image ↓ just tell me and I'll try again. If you prefer, I can also describe it or lay it out in a simple text diagram.

Good, but succinct response.

When asked, generated a wheel on-the-fly.  
Basic, some artifacts (radiation), misses gravity and biological, errored out on first attempt.



Good response, but missed mechanical and biological.

- The **energy-based approach** in occupational safety, often attributed to the work of Dr. William Haddon Jr. and his **Energy Damage and Countermeasure Strategies**, is a scientific framework that views all injuries and damage as the result of **unwanted or excessive transfer of energy**.

This approach shifts the focus from simply looking at the sequence of human errors or unsafe conditions that lead to an "accident" to the **fundamental physical cause of the injury**—the energy itself.

#### Core Concept: Energy Transfer

The central idea is that an injury occurs when the human body is exposed to energy (or a lack of a vital energy like oxygen) in amounts or at rates that exceed its injury tolerance threshold.

The goal of the safety professional, using this model, is to **control the hazardous energy** to prevent the injury. The types of hazardous energy in a workplace can include:

- Kinetic/Motion:** Moving vehicles, falling objects, rotating machinery.
- Thermal:** Extreme heat (burns, fire) or cold (frostbite).
- Electrical:** Current and static electricity.
- Chemical:** Explosives, toxic or corrosive substances.
- Acoustic/Sound:** High-level noise.
- Radiation:** X-rays, gamma rays, non-ionizing radiation.
- Gravity:** Falls from heights.
- Pressure:** Compressed air or hydraulic systems.

#### Haddon's Ten Countermeasure Strategies

Dr. Haddon developed a logical sequence of **Ten Strategies** for preventing injuries by controlling this energy transfer. These strategies, which form the intervention component of the energy-based approach, are generally ranked from most effective (preventing the energy buildup) to least effective (treating the damage after the event).

# Gemini !

When asked, retrieved a wheel from a web search and gave all ten correct sources. The wheel shows different names than the text response, though.

- The **Energy Wheel** is a visual tool used in the energy-based safety approach to help workers systematically identify all potential sources of hazardous energy on a job site, especially those that are often overlooked.

Here is the image of a safety Energy Wheel:



The wheel typically categorizes the types of energy that can cause serious injuries or fatalities (SIFs), prompting workers and supervisors to scan the environment for hazards related to each one.

Common energy categories found on the wheel include:

- Gravity:** Falls from height, falling objects.
- Motion (Kinetic):** Moving equipment, traffic, projectiles.
- Mechanical:** Rotating, crushing, or vibrating machinery.
- Electrical:** Contact with live wires, static discharge.
- Pressure:** Compressed air, hydraulic lines, vacuum systems.
- Thermal (Temperature):** Hot surfaces, steam, extreme cold.
- Chemical:** Flammable, reactive, or corrosive substances.
- Acoustic (Sound/Vibration):** Excessive noise from equipment.
- Radiation:** Welding flash, UV from the sun, X-rays.
- Biological:** Living organisms posing a health risk (e.g., pathogens).

# Claude



A What's the energy-based approach in occupational safety?

The energy-based approach in occupational safety is a systematic framework for identifying and controlling workplace hazards by analyzing the flow and transfer of energy that can cause harm to workers.

A Can you show me the energy wheel?

I can create a visual representation of the energy wheel used in occupational safety.

This diagram shows the different types of energy that can cause harm in the workplace.

Occupational Safety Energy Wheel  
Image

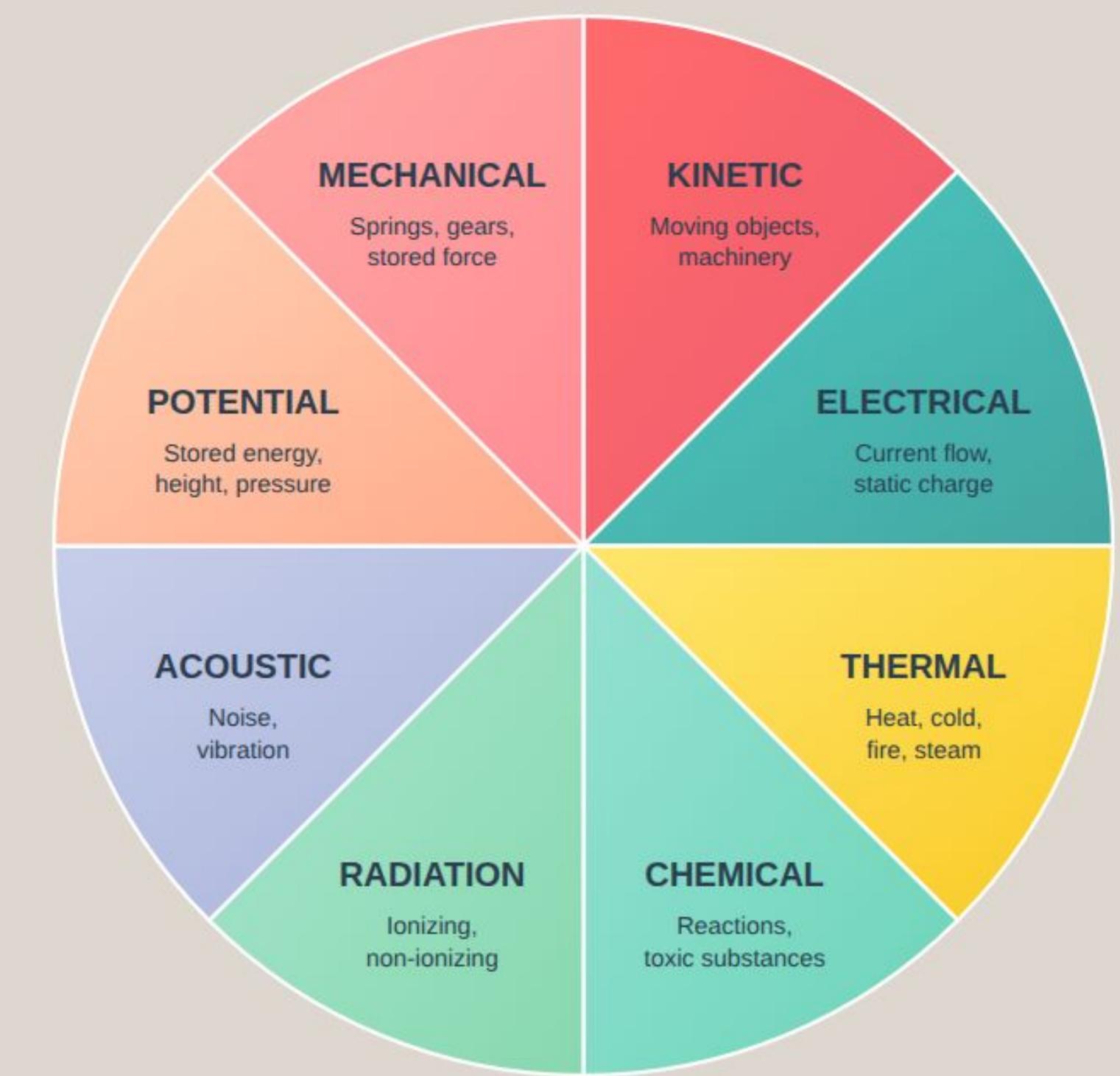
This energy wheel illustrates the eight major types of energy that safety professionals assess when identifying workplace hazards:

1. **Kinetic** - Motion and moving objects
2. **Electrical** - Electric current and static
3. **Thermal** - Heat and cold extremes
4. **Chemical** - Reactions and toxic substances
5. **Radiation** - Both ionizing and non-ionizing
6. **Acoustic** - Noise and vibration
7. **Potential** - Stored energy from height or pressure
8. **Mechanical** - Stored mechanical force

Safety professionals use this wheel as a checklist to ensure they've considered all possible energy sources when conducting hazard assessments and designing control measures for a workplace or task.

# Good response, but missed pressure and biological.

When asked, generated a wheel on-the-fly (still misses pressure and biological).



# Visual Hazard Recognition

# Visual Hazard Recognition

Back to query and photo from the beginning:

“Identify all hazards and show them to me on the photo.”





Step-by-step hazard identification and recommended direct controls

1) Mobile equipment proximity — hazard: worker is very close to an operating excavator and a walk-behind compactor. Risk: struck-by, crush, or run-over.

- Direct controls: establish and enforce physical exclusion zone (concrete barriers or heavy-duty fencing) around operating equipment; use a trained dedicated spotter; lockout or park equipment when workers are within the zone.

2) Excavator on loose aggregate mound — hazard: machine stability and rollaway risk; sudden movement or collapse of pile beneath tracks.

- Direct controls: reposition excavator to stable, level ground; use barriers to prevent travel onto loose piles; chock and apply parking brake when parked.

3) Swing radius and counterweight exposure — hazard: worker inside excavator's swing area could be struck by boom or counterweight.

- Direct controls: mark swing radius physically (barricades), require operator/spotter communication, use proximity alarms.

4) Working on sloped/uneven surface and loose material — hazard: slips, trips, falls; compactor operator stance compromised.

- Direct controls: re-grade walk path or plate/compact a stable walkway; place anti-slip matting or temporary ramp; remove loose debris from travel areas.

5) Inadequate separation between pedestrian work and compaction operation — hazard: hand/foot injuries from compactor or being caught between machines.

- Direct controls: implement temporary guard rails or interlocked guards around compaction area; operate compactor only from designated operator position; ensure two-hand/guard systems are in place.

6) Lack of visible exclusion signage or physical barriers at edge of work area — hazard: unauthorized entry and vehicular intrusion.

- Direct controls: install rigid barricades and high-visibility fencing; post signage and use flaggers for traffic control.

7) Trip hazards from stakes, tubing, and small equipment on ground — hazard: workers may trip and fall into equipment path or down slope.

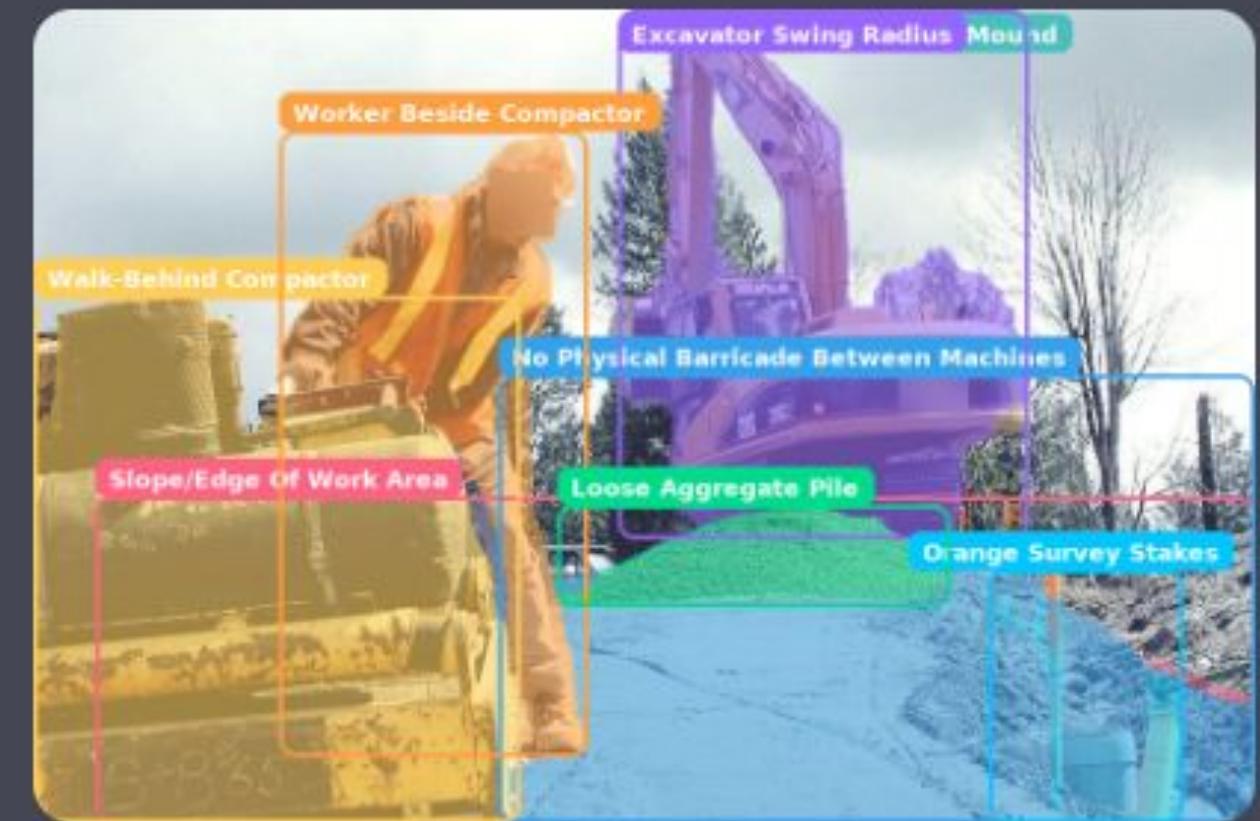
- Direct controls: clear and re-route utilities/markers away from walking path; place protective covers or highly visible barriers.

Photo-specific extraction for annotation

Photo-specific extraction for annotation

### ✿ Items to show on the photos:

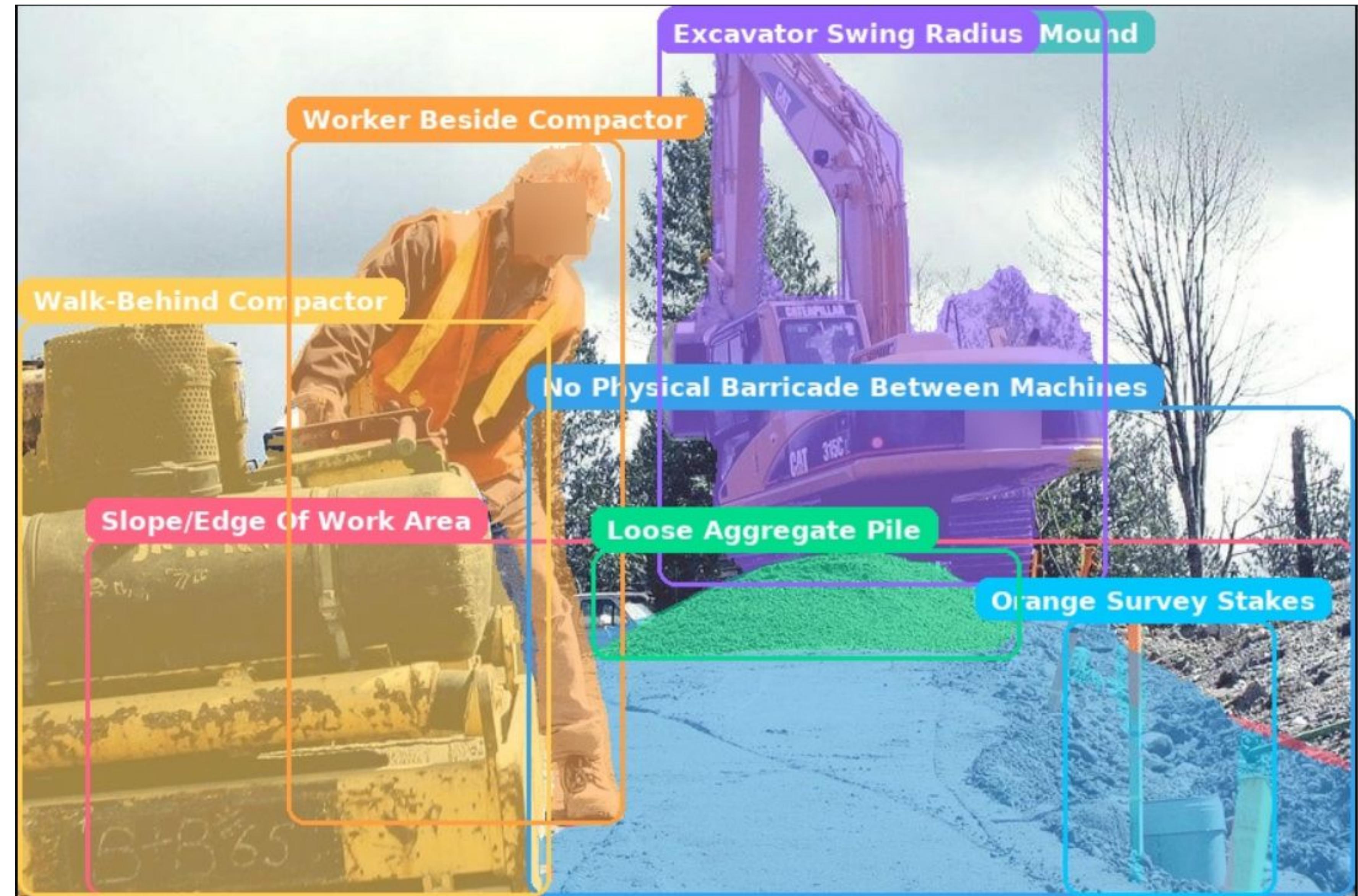
eee319d357667e5e2ebd3212d303af6f\_jcdzhrdoftzghrbq\_chatID=167.jpg: worker beside compactor; walk-behind compactor; excavator on aggregate mound; loose aggregate pile; excavator swing radius; slope/edge of work area; orange survey stakes; no physical barricade between machines



**Text + visual response that lists hazards, recommends direct controls, and annotates the photo.**



Advanced visual annotations with open-vocabulary bounding boxes and segmentation masks ➤



This photo shows John Doe from Placeholder Construction Ltd.  
Identify all hazards and show them to me on the photo.



Here are the highlighted hazard areas. Let me know if you want labels added directly on the image or more precise bounding. ↵

Yes please



Done. Let me know if you want the labels styled differently or the boxes adjusted. ↵

## Visual-only response, annotations are inaccurate and incomplete.



This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.

I've identified some potential hazards in the image you sent. Here they are highlighted:



Visual-only response,  
annotations are incomplete  
and contain hallucination:  
“overhead power lines”.



# Claude !

SAFETY A

A This photo shows John Doe from Placeholder Construction Ltd. Identify all hazards and show them to me on the photo.

I can help you identify safety hazards in this construction site photo, but I want to note that I cannot identify the specific person in the image - I can only analyze the safety conditions shown.

Here are the hazards I can identify from this construction scene:

#### Visible Safety Hazards:

1. **Working on/near heavy equipment** - The worker is standing on or very close to equipment (appears to be a compactor roller) while an excavator is operating nearby
2. **Unstable footing** - Standing on curved/rounded equipment surfaces creates fall risk
3. **Working in the swing radius** - The worker is within the dangerous swing radius of the operating excavator
4. **Lack of high-visibility PPE on lower body** - While wearing a safety vest, the light-colored pants provide poor visibility
5. **Potential crush/pinch points** - Positioning between equipment creates multiple crush zones
6. **Unmarked/poorly marked work zone** - Limited traffic control devices visible (only one small cone/marker)
7. **Equipment communication concerns** - No visible spotter or clear communication



Good response, but text-only, refuses to annotate photo.

A Show them to me on the photo.

I appreciate your request, but I'm not able to edit or mark up photos directly to show you the hazards visually. However, I can describe where each hazard is located in the image more specifically:

#### Hazard Locations in the Photo:

1. **Center-left foreground:** Worker standing ON the yellow compactor roller - unstable platform, fall risk

A Can you annotate the photo with bounding boxes and segmentation masks?

I apologize, but I don't have the ability to add visual annotations like bounding boxes or segmentation masks directly onto images. I can only view and analyze images, not edit or mark them up with graphical overlays.

# Visual Energy Recognition

# Visual Energy Recognition

SAFETY A

“Can you determine all the sources of energy that are present in this scene and show them to me on the photo?”



# ChatSafetyAI



SAFETY A

Can you determine all the sources of energy that are present in this scene and show them to me on the photo?

A Step-by-step energy identification (photo: hotwork\_uotqzvkcpenfkqx\_chatID=177.jpg)

- Mechanical energy: worker is operating a powered cutting/grinding tool (rotating disc or cutting torch visible at contact point). This tool contains stored/kinetic mechanical energy and moving parts — direct source of cutting forces and flying particles.
- Thermal energy: the bright cutting zone and glowing sparks indicate high temperatures at the cut (hot metal, molten droplets) capable of burns and ignition.
- Motion (kinetic) energy: visible trajectories of sparks and metal particles flying outward; those particles and any moving debris can impart kinetic energy to workers or objects.
- Electrical energy: electrical cable(s) and a power fan/box are visible behind the worker, indicating energized equipment and electrical supply to the tool.
- Gravity (potential energy): the worker is cutting over an open gap between steel members (drop beneath the deck). The open space and elevated work surface present fall-to-lower-level potential energy for the worker or falling objects.
- Radiation (optical/UV): the intense bright cutting arc/zone emits intense light (visible radiation and possibly UV) that can damage eyes/skin if unshielded.
- Sound energy: powered cutting/grinding operations generate high noise levels (the tool and nearby equipment are visible sources).

Controls observed (brief):

- PPE: hard hat, high-vis jacket, and what appears to be a harness (fall protection) on the worker — partial controls for head protection and fall arrest. Eye/face protection not clearly visible due to blur.
- Ventilation/fan visible (air mover) — may be used to disperse fumes/sparks.

- No visible welding curtains, spark shields, or exclusion barriers beneath the cut; drop zone under the cut appears unprotected.

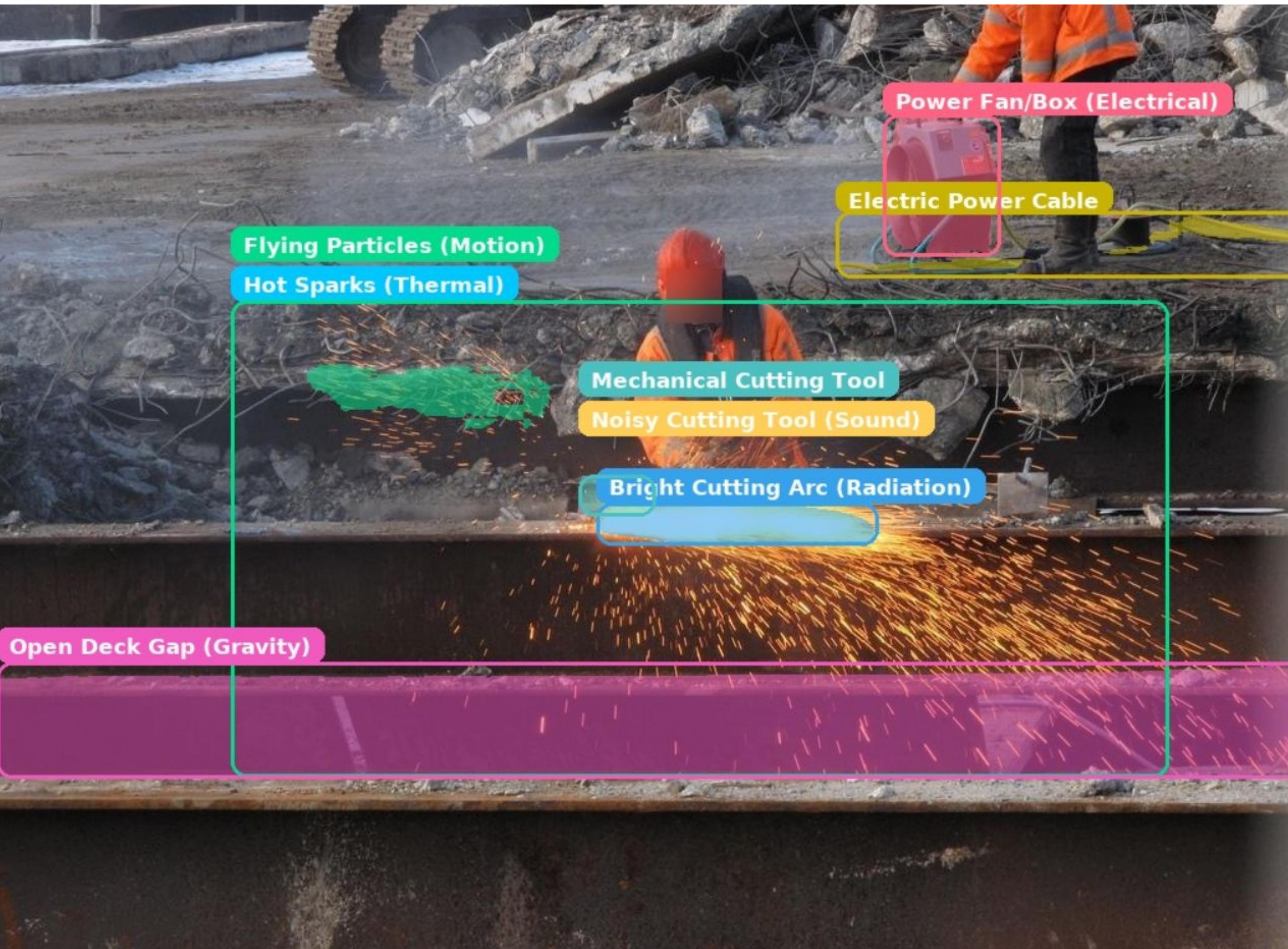
Key hazards from the energies above: burns/ignition (thermal), eye/skin damage (radiation), struck-by from flying particles (mechanical/kinetic), electric shock (electrical), fall to lower level or dropped-object (gravity), hearing damage (sound).

✿ Items to show on the photos:

hotwork\_uotqzvkcpenfkqx\_chatID=177.jpg: mechanical cutting tool; hot sparks (thermal); flying particles (motion); electric power cable; power fan/box (electrical); open deck gap (gravity); bright cutting arc (radiation); noisy cutting tool (sound)



Gets all sources correct and  
annotates photo.



ChatSafetyAI vs Others,  
Antoine Tixier,  
[www.safetyai.io](http://www.safetyai.io)

# ChatGPT X

SAFETY A

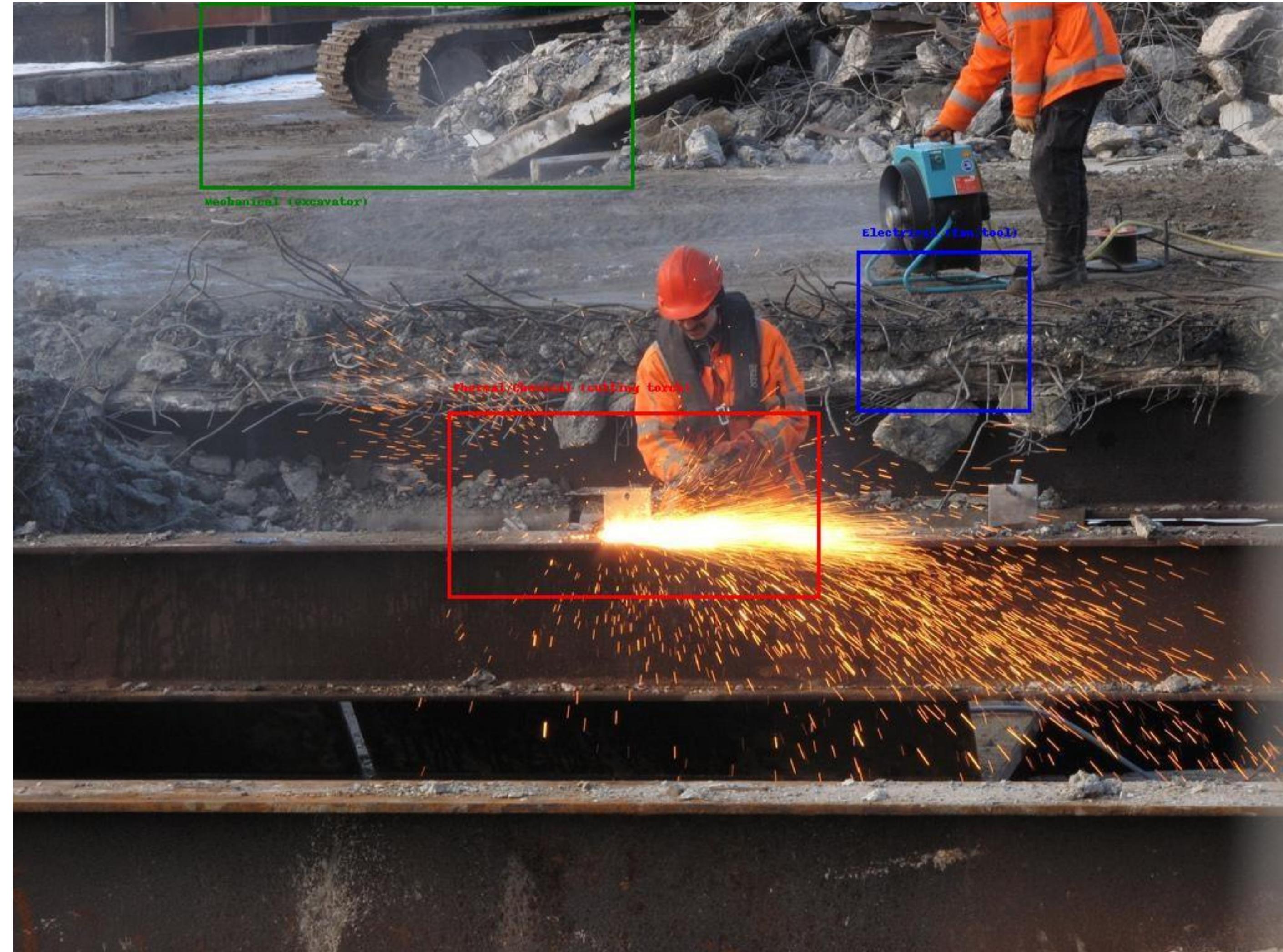


Can you determine all the sources of energy that are present in this scene and show them to me on the photo?

Here's the annotated image marking the visible energy sources:

[Download annotated image](#)

No text response, incomplete and poorly placed annotations, barely readable labels.



Can you determine all the sources of energy that are present in this scene and show them to me on the photo?

Analysis ▾

The image primarily depicts a **hot work** operation, likely **thermal cutting** of steel beams during a demolition or construction project.

Based on the scene, here are the main sources of energy present:

#### ⚡ Energy Sources

- **Thermal Energy (Heat):** The most prominent source is the **intense heat** generated at the cutting point. This heat is necessary to melt and sever the metal. It's visible as the bright, incandescent material and sparks.
- **Radiant Energy (Light):** This is the **bright visible light** emitted from the hot work operation. It is a form of electromagnetic radiation and is a byproduct of the intense thermal energy. The sparks and the arc/flame itself are major sources of this.
- **Kinetic Energy (Motion):**
  - **Sparks/Molten Metal:** The **flying sparks** and molten material ejected from the cut have kinetic energy due to their motion.
  - **Worker/Equipment:** The **worker's movements** and the potential **operation of the machinery** (like the tracked vehicle in the background) represent kinetic energy.
- **Chemical Energy (Potential):** This energy is stored within the fuel source used for the cutting process. While the exact method isn't clear (could be oxy-fuel cutting or arc cutting), a **cutting fuel** (e.g., acetylene, propane, natural gas) or the **electrical current's source** (e.g., batteries, power grid, or fuel for a generator) holds stored chemical energy that is being rapidly converted into heat and light.
- **Sound Energy:** Although not visible, the **noise** generated by the cutting process (the sound of the flame/arc, the severing metal, and any associated machinery) is a form of energy.

#### 🔍 Visual Indication on the Photo

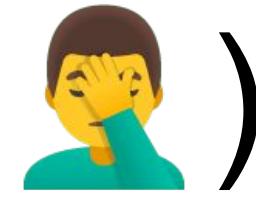
Since I cannot directly annotate the image, I will describe where each source of energy is primarily located or represented:

Energy Source Primary Location / Representation

Thermal The **cutting point** where the bright light is being generated, and the immediate area of

Gemini !

SAFETY AI

Decent response, but misses gravity, and refuses to annotate the photo (had accepted for the previous photo ).

Show me the energy sources directly on the photo

◆ I apologize, but as an AI, I **cannot directly draw on or annotate** the image file you uploaded.

However, I can provide a very clear, descriptive guide and an **annotated text representation** of where you would physically point to each energy source on the photo:

# Claude !

SAFETY AI

A Can you determine all the sources of energy that are present in this scene and show them to me on the photo?

I can see several energy sources in this demolition/construction scene. Let me identify them for you:

## Energy Sources Present:

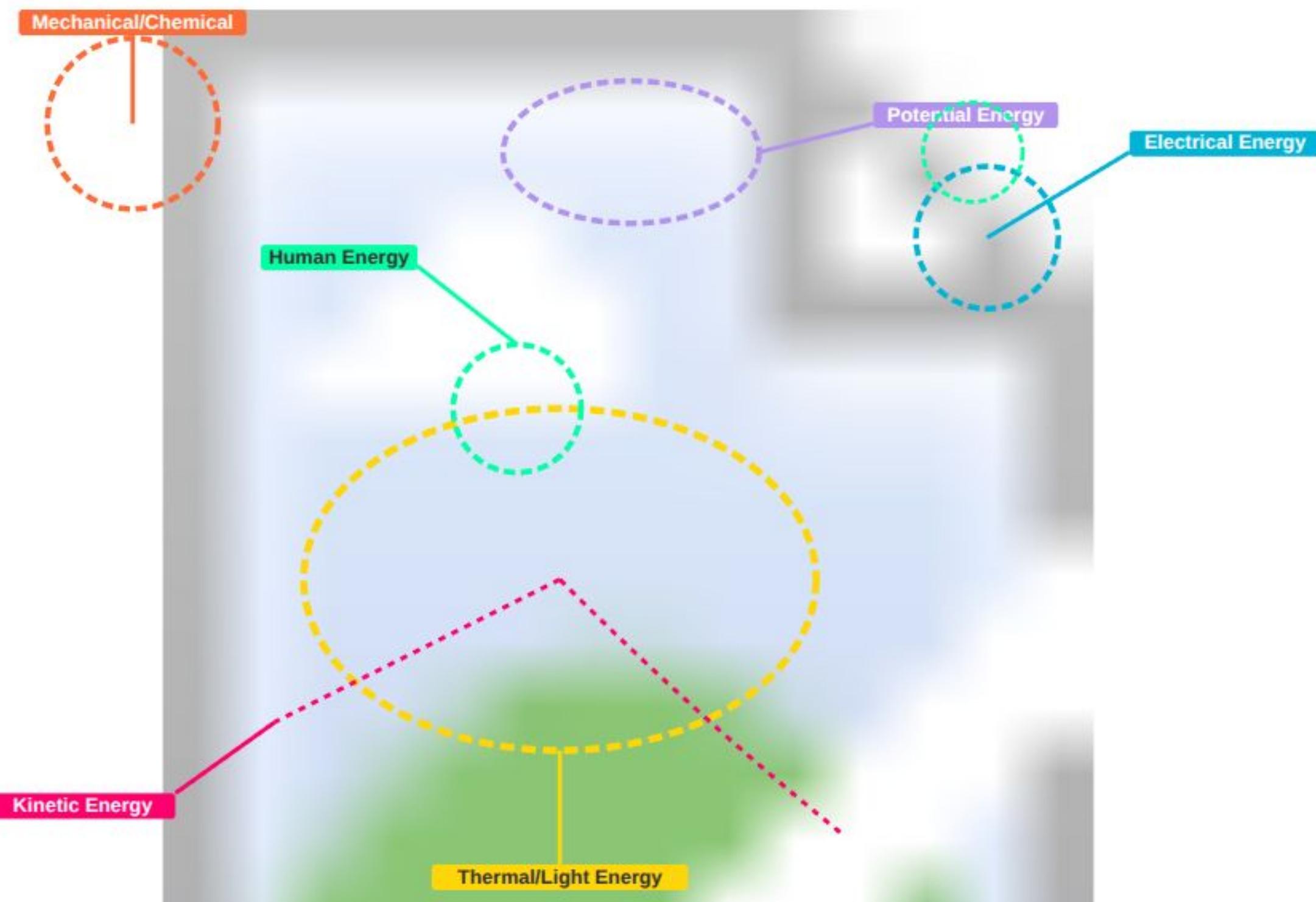
1. **Electrical Energy** - The blue welding machine/generator in the upper right that the worker is operating, plus any power running to equipment
2. **Chemical Energy** - Fuel stored in the excavator (visible in background) and potentially in the welding equipment
3. **Thermal Energy** - The intense heat from the cutting torch creating those dramatic sparks (likely an oxy-fuel or plasma cutting torch)
4. **Kinetic Energy** - The movement of the excavator's tracks and arm, the falling sparks, and workers' movements
5. **Mechanical Energy** - Stored in the hydraulic systems of the excavator
6. **Light Energy** - The bright flame/arc from the cutting operation and the sparks radiating outward
7. **Human Metabolic Energy** - The workers performing physical labor
8. **Potential Energy** - In the elevated excavator arm and the pile of rubble/debris that could fall



Good text response, accepts to annotate (had refused for the previous photo 🤖), but annotations are very basic, and inaccurate.

Would you like me to create an annotated version of the image highlighting where these different energy sources are located?

A Yes please



# Visual Energy Recognition II

SAFETY A

Another photo and query:

“Can you show me all sources of energy on this photo?”



# ChatSafetyAI



SAFETY A

Can you show me all sources of energy on this photo?

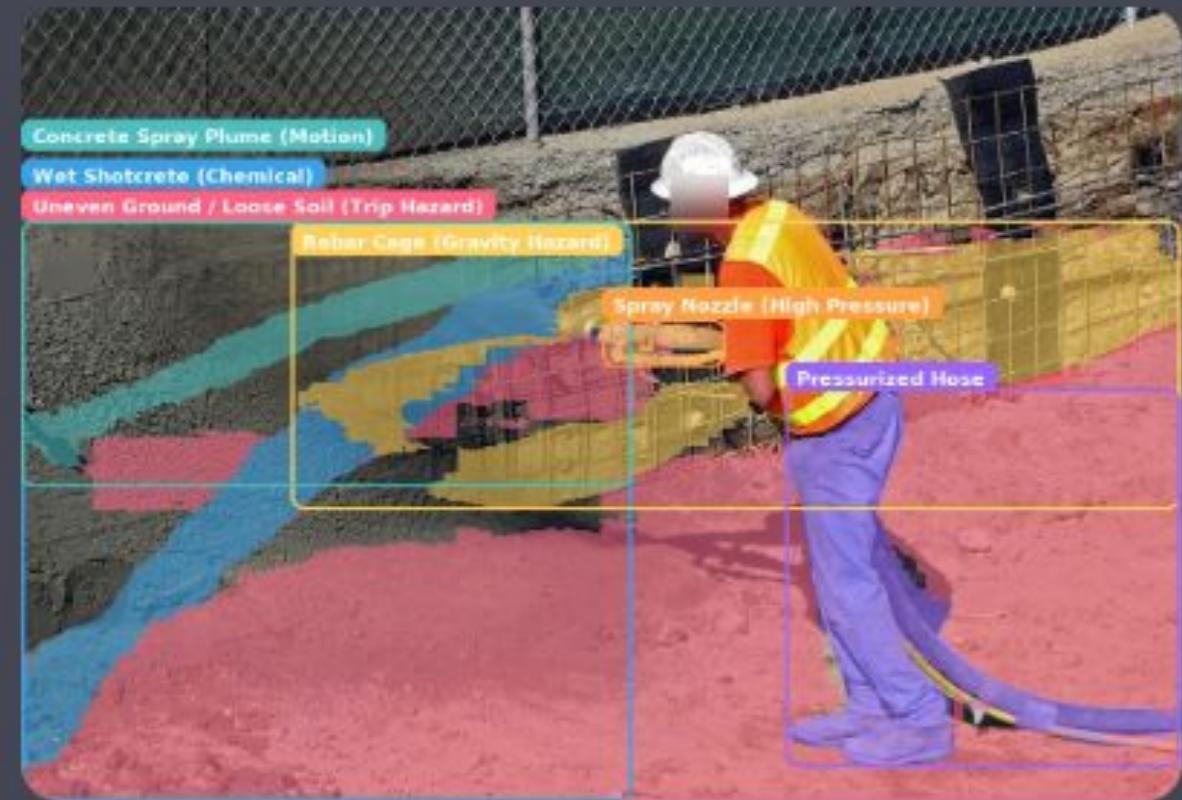
A Step-by-step energy sources visible and why they matter (brief):

- Pressure — Pressurized hose and nozzle: the hose/nozzle are visibly under pressure while spraying shotcrete. Failure (hose burst, nozzle blowback) can release high-pressure fluid energy causing impact or injection injuries. Control: pressure-rated hose, whip checks, PPE (face shield), keep clear zones.
- Motion (kinetic energy) — Concrete spray plume and moving hose/nozzle: high-velocity spray and the swinging hose can strike workers or cause loss of balance. Control: hose restraint/whip restraint, two-person handling, maintain footing.
- Mechanical — Shotcrete pump/nozzle assembly (hand-held mechanical device): mechanical forces inside the pump and nozzle drive material; moving parts and recoil can cause crush/entanglement hazards. Control: guarding where accessible, secure coupling, safe handling procedures.
- Chemical — Wet shotcrete (cementitious material): exposure risks (skin irritation, chemical burns, respiratory dust/vapors). Control: chemical-resistant gloves, long sleeves, eye protection, respiratory protection for dust/aerosols, wash stations.
- Gravity — Rebar cage and work platform/edge: exposed rebar and vertical face create fall/impact hazards (material falling onto workers, or a worker falling). Control: guardrails or exclusion zone above/below, rebar caps, secure footing.
- Gravity (same-level) — Uneven ground and loose material underfoot: trip or slip that can lead to falls while handling hose. Control: housekeeping, stable footing, designated walkways, anti-slip footwear.

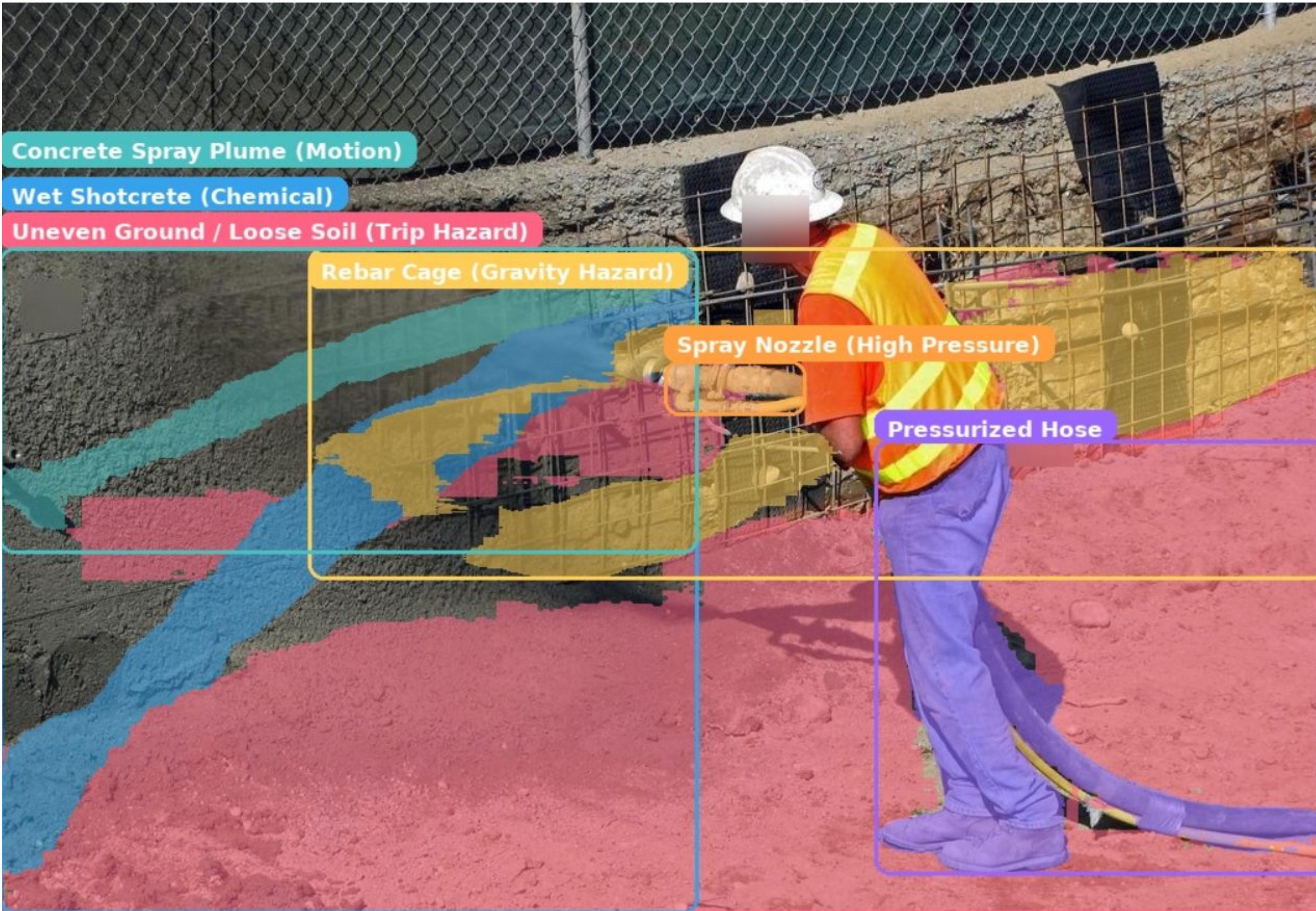
Notes on controls visible/needed: worker is wearing helmet and hi-vis vest (PPE present) but add face/eye protection, respirator for aerosol, hose restraints, and clear exclusion zone downrange of spray. Do not assume off-frame equipment (e.g., pump) — recommendations focused on visible items.

★ Items to show on the photos:

shotcrete\_nxcdfurjylgzqpfn\_chatID=176.jpg: pressurized hose; spray nozzle (high pressure); concrete spray plume (motion); wet shotcrete (chemical); rebar cage (gravity hazard); uneven ground / loose soil (trip hazard)



Gets all sources correct and  
annotates photo.



ChatSafetyAI vs Others,  
Antoine Tixier,  
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Missed motion,  
mechanical,  
chemical, and  
gravity.



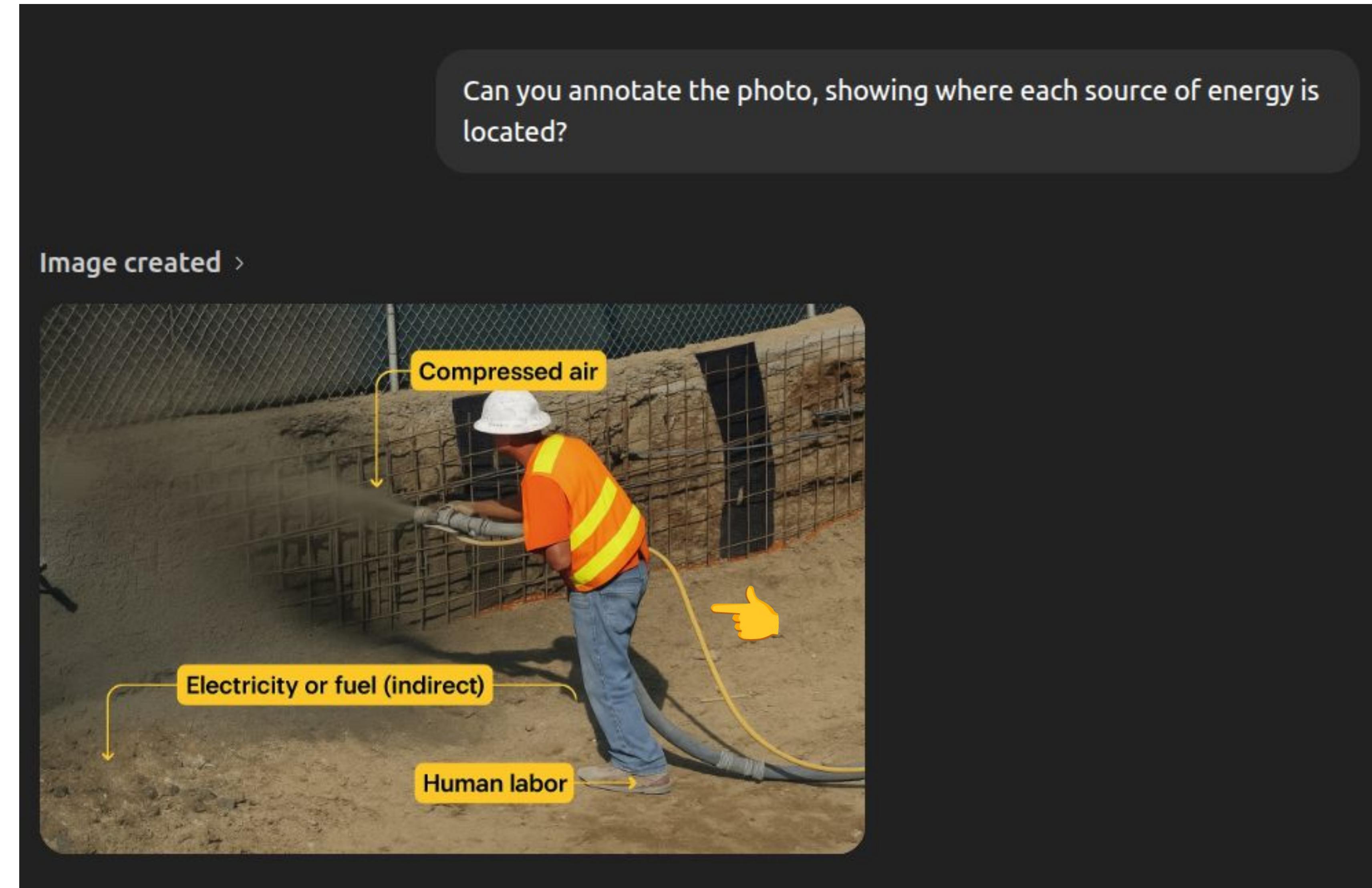
Can you show me all sources of energy on this photo?

In the photo, the visible sources of energy are:

1. **Compressed air** – powers the spray nozzle to project the concrete mix (shotcrete) onto the wall.
2. **Electricity or fuel (indirect)** – powers the air compressor and mixing equipment, though these are off-frame.
3. **Human labor** – the worker's physical effort directing and controlling the hose.

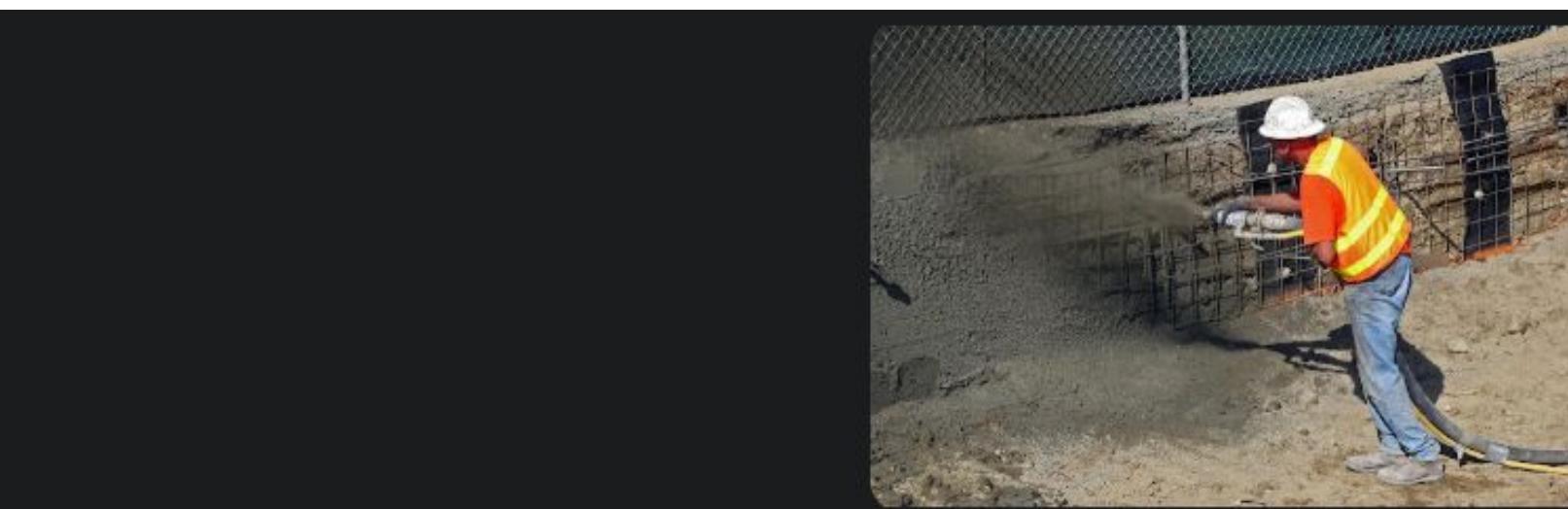
No other active energy sources are visible in the image itself.

When asked to annotate the photo, generated a copy of the original one, with artifacts (notice the position of the yellow hose) and inaccurate label placement.





Good response,  
but missed  
mechanical  
(hose recoil)  
and included  
worker's  
metabolic  
energy  
(irrelevant).



Can you show me all sources of energy on this photo?

Show thinking ▾

Based on the visual evidence in the photo, we can identify several distinct forms of energy at work. This scene captures a dynamic process called **shotcrete application** (spraying concrete at high velocity), which involves converting various energy forms to build a structure.

Here is a breakdown of the energy sources visible or implied in this image:

#### 1. Kinetic Energy (Energy of Motion)

The most obvious form of energy here is movement.

- **The Shotcrete Spray:** The concrete mixture is flying out of the nozzle at high speed. This is **kinetic energy**. The material needs this velocity to compact itself tightly against the wall without needing formwork.
- **The Worker:** The construction worker is bracing his body and moving his arms to direct the heavy nozzle.

#### 2. Pneumatic and Hydraulic Energy (Pressure)

While the pump itself is likely off-camera, the effects are clearly visible in the hose.

- **Compressed Air (Pneumatic):** To shoot concrete at that speed, a massive amount of compressed air is being forced through the line. This stores potential energy in the form of pressure.
- **Fluid Pressure (Hydraulic):** The wet concrete is being pushed through the heavy black hose. The stiffness and curve of the hose indicate it is under significant internal pressure.

**Note on the Hidden Source:** The pressure in the hose is likely generated by a diesel engine or electric motor located nearby (the shotcrete rig). This represents a conversion of **Chemical Energy** (diesel fuel) or **Electrical Energy** into the mechanical

#### 3. Chemical Energy

There are two distinct chemical processes happening here:

- **Metabolic Energy (Biological):** The worker is converting the chemical energy from food into the mechanical energy required to stand firm, hold the heavy hose, and withstand the "kickback" force of the nozzle.
- **Exothermic Reaction (Concrete Curing):** As the wet cement hits the wall and begins to set, it undergoes a chemical reaction called **hydration**. This reaction releases heat. While we can't "see" the heat, the chemical potential energy within the grey mixture is currently being released to turn the liquid into a solid solid.

#### 4. Radiant and Thermal Energy

- **Solar Energy:** The sharp shadows (visible under the worker and the hose) and the bright lighting indicate strong sunlight. This provides **radiant energy** (light) allowing the worker to see, and **thermal energy** (heat), which warms the ground, the worker, and the equipment.

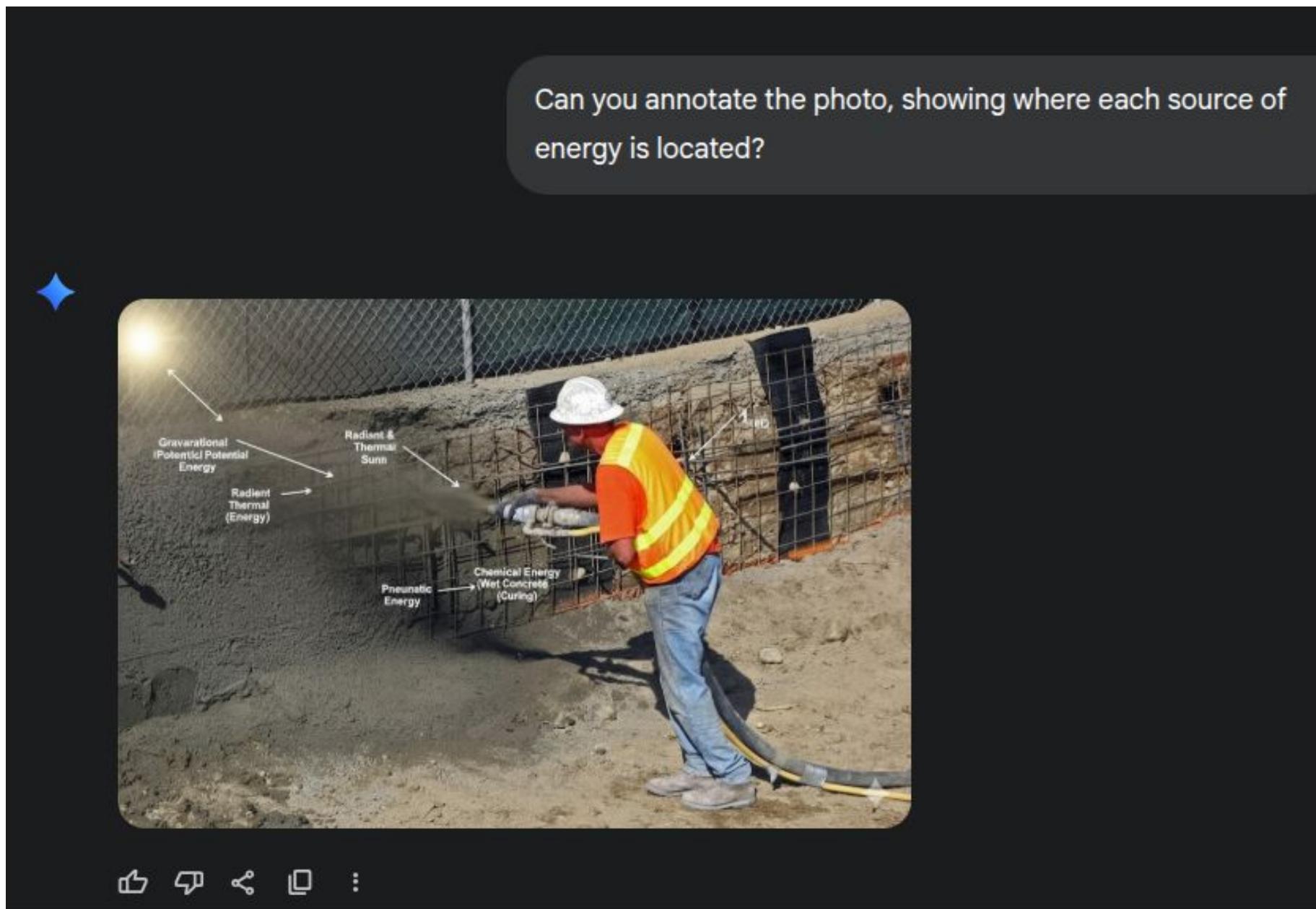
#### 5. Gravitational Potential Energy

- **The Slope:** The earth bank is steep. Gravity is acting on the soil, pulling it down. The mesh (rebar) and the shotcrete are being applied to counteract this potential energy and prevent a landslide.
- **The Hose:** The heavy hose is draped on the ground; the worker must lift it against gravity to aim it.

# Gemini



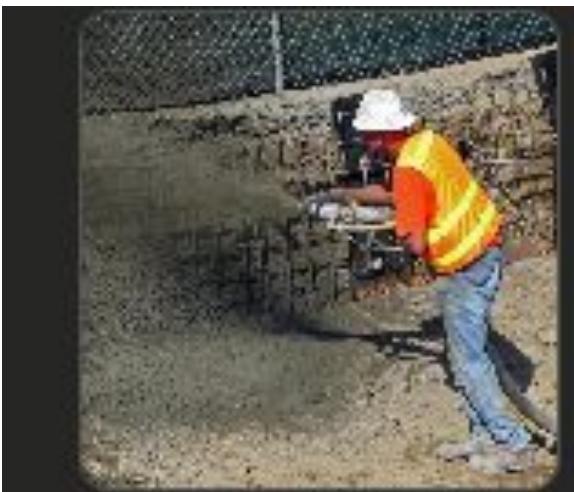
SAFETY A



Unable to properly annotate photo: generated a copy of it with artifacts (light source in the upper left corner), misplaced and improperly wrote labels.



## Missed mechanical and gravity.



A

Can you show me all sources of energy on this photo?

Looking at this construction photo, I can identify several sources of energy:

1. **Human/Worker** - The construction worker himself is an energy source, using muscular energy to operate the equipment and perform the work.
2. **Compressed Air/Pneumatic System** - The worker is using what appears to be a pneumatic spray gun or compressor-powered tool for applying shotcrete/concrete. The yellow hose trailing on the ground is likely delivering compressed air or concrete mix under pressure.
3. **Electrical Power (indirect)** - While not directly visible, the compressor or pump system supplying the material/air pressure would be powered by electricity, likely from the construction site's power supply.
4. **Potential Energy** - The wet concrete/shotcrete being applied contains chemical potential energy in its cement compounds that will be released during the curing/hydration process.

## Unable to annotate photo, produces basic diagram.

Energy sources in photo ▾

the reinforced wall structure.

A Can you annotate the photo, showing where each source of energy is located?

I'll create an annotated version of the photo highlighting each energy source.

Energy Sources in Construction Photo

Image

I've created an annotated diagram showing the five energy sources in the construction photo:

1. Human Energy (Red) - The worker using muscular power to control the equipment
2. Compressed Air (Blue) - The pneumatic spray gun applying the shotcrete
3. Supply Hose (Yellow/Gold) - The pressurized delivery system on the ground
4. Chemical Energy (Green) - The wet concrete being applied, which contains energy released during curing
5. Electrical Power (Purple) - The off-screen compressor/pump system powering the operation

Each source is circled with a dashed line and labeled with arrows pointing to descriptive text. The 1st annotation is for the worker's muscular power.

ENERGY SOURCES

- Human muscular energy
- Compressed air system
- Chemical (concrete curing)
- Electrical (off-screen)

1. HUMAN ENERGY  
(Muscular power)

2. COMPRESSED AIR  
(Pneumatic spray gun)

3. SUPPLY HOSE  
(Pressurized system)

4. CHEMICAL ENERGY  
(Concrete curing)

5. ELECTRICAL POWER  
(Off-screen compressor)

# HECA

## *High-Energy Control Assessment*

# HECA - Jargon

First, let's test whether the chatbots know what is HECA at all, by asking for some acronyms (the grouping providing the context):

“What do the acronyms PPE, HECA, and SCL mean?”

# ChatSafetyAI



SAFETY A



What do the acronyms PPE, HECA, and SCL mean?



Here's a quick explanation of each acronym:

Acronym	Meaning	Description
PPE	Personal Protective Equipment	Equipment worn to minimize exposure to hazards that cause injuries and illnesses (e.g., hard hats, gloves, safety glasses, high-visibility clothing).
HECA	High-Energy Control Assessment	A systematic process to identify high-energy hazards on a job site and confirm that direct, error-proof controls are in place to prevent serious injuries or fatalities.
SCL	Safety Classification and Learning	A model used to classify incidents and observations based on energy presence, incident severity, and controls, to identify events with serious injury or fatality potential and support shared learning.

Let me know if you'd like more details on any of these! ▶



What do the acronyms PPE, HECA, and SCL mean?

Thought for 20s >

Here are common meanings by context:

- **PPE**
  - Personal Protective Equipment (safety/health)
  - Philosophy, Politics and Economics (university degree)
- **HECA**
  - Cairo International Airport (ICAO code)
  - Home Energy Conservation Act (UK)
  - Higher Education Colleges Association (Ireland)
- **SCL**
  - Santiago, Chile airport (IATA code)
  - Student-Centered Learning (education)
  - Standard Cell Library (chip design)





What do the acronyms PPE, HECA, and SCL mean?

Show thinking ▾

These acronyms are most likely related to **Industrial Safety and Serious Injury/Fatality (SIF) Prevention**, specifically within frameworks used by organizations like the **Edison Electric Institute (EEI)**.

However, if you are asking about them in isolation, they have other common meanings in academia and law.

## 1. The Safety & Industrial Context (Most Likely)

If you saw these terms together (e.g., in a safety report, utility company meeting, or construction site), they refer to modern safety management systems designed to prevent severe accidents.

- **PPE (Personal Protective Equipment):** The "last line of defense" for a worker. This includes gear like hard hats, safety glasses, high-voltage gloves, and fire-resistant clothing designed to protect the body from injury.

Very good, even though includes irrelevant definitions at the end.

- **HECA (High-Energy Control Assessments):** A proactive safety metric. Instead of just counting injuries, HECA measures the presence of "direct controls" on high-energy hazards (like high voltage, gravity, or pressure). It calculates the percentage of high-energy hazards that are effectively neutralized by a physical barrier or engineering control (rather than just relying on a worker paying attention).
- **SCL (Safety Classification and Learning):** A model used to categorize safety incidents based on their *potential* severity rather than just the actual outcome. It helps companies distinguish between a low-risk "boo-boo" and a "high-potential" near-miss that could have killed someone, allowing for better learning and prevention.

## 2. General & Other Common Meanings

If the safety context does not fit, here are the standard definitions for each acronym individually:

### PPE

- **Personal Protective Equipment:** (Universal) Safety gear as described above.
- **Philosophy, Politics, and Economics:** (Academic) A prestigious interdisciplinary undergraduate degree course, most famously taught at the University of Oxford.

### HECA

- **Higher Education Consultants Association:** A professional organization for independent college admissions consultants.

A What do the acronyms PPE, HECA, and SCL mean?

These acronyms can have multiple meanings depending on the context, but here are the most common ones:

**PPE - Personal Protective Equipment** This refers to protective gear like gloves, masks, goggles, helmets, and other items worn to minimize exposure to hazards. It's commonly used in healthcare, construction, manufacturing, and laboratory settings.

**HECA** - This one is less standardized, but common meanings include:

- **Home Energy Conservation Act** (U.S. legislation)
- **Higher Education Consultants Association**
- In some contexts, it might refer to specific organizational or regional acronyms

**SCL** - Several possibilities:

- **Supply Chain Logistics**
- **Student Centered Learning** (in education)
- **Standard Cell Library** (in electronics/chip design)
- **Social and Communication disorders/Language** (in special education contexts)

Could you provide more context about where you encountered these acronyms? That would help me identify which specific meanings are relevant to your situation.

# HECA I

"Do a HECA with the following info:

- Task is transformer replacement
- 8 ft deep vault next to traffic
- Vault is de-energized, verified and grounded
- Load is 3000lbs moving at 4 mph
- 1 am, temperature 30F
- Traffic is blocked by machinery and work vehicles that can handle the energy of traffic incursion
- Transformer is rigged properly
- Crane is not moving but the load is being lowered
- Air monitoring indicated no toxic chemical in vault"

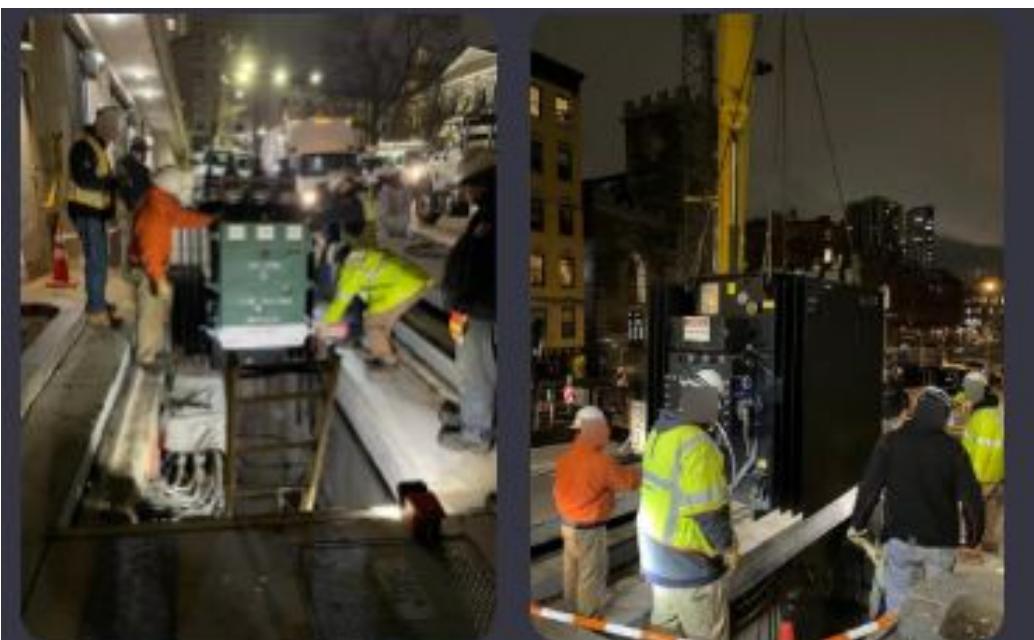


Follows HECA logic to identify all HE hazards and direct controls...

# ChatSafetyAI



SAFETY AI



Do a HECA with the following info:

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## A Step 1. 🌈 High-Energy Hazard Identification

- Heavy suspended load (transformer ~3000 lb): large mass at height; potential for SIF if dropped or swung (gravity + motion).
- Moving/lowered load (transformer being lowered): kinetic energy while lowering can strike workers or crush (motion).
- Fall from greater than 4 ft (8 ft deep vault / open vault opening): workers at vault edge and ladder access present a high fall energy exposure.
- Mobile equipment / traffic with workers on foot (adjacent roadway, work vehicles/machinery blocking traffic): potential vehicle impact or struck-by (motion).
- Electrical contact >50 V (transformer and associated cables): presence of electrical apparatus—

electrocution/arc risk even if claimed de-energized (electrical).

- Confined-space atmospheric hazard (8 ft vault): potential for hazardous atmosphere—though monitoring reported clear, the confined geometry is a hazard (chemical/biological/radiation sources if present).
- Crushing / pinch hazard from load landing or contact with vault walls/equipment (mechanical): risk of crushing between load and vault structure or tools.

## Step 2. 🛡 Direct Control Assessment

### Heavy suspended load (transformer)

- Rigged properly (mentioned & visible): Targeted? Yes — rigging is specifically for securing the transformer. Effective? Yes — a properly rated rigging assembly mitigates uncontrolled drop/shift. Error-proof? Yes — once correctly installed and rated hardware is in place it is passive and not reliant on operator action during lowering.

### Moving/lowered load (transformer being lowered)

- Rigging + crane lift control (rigging visible; crane holding/controlling lowering): Targeted? Yes — controls directly address motion of the load. Effective? Partly — rigging and crane control can arrest motion, but lowering operations remain operator-dependent for speed/position. Error-proof? No — lowering typically requires operator action (not fully error-proof).

### Fall from >4 ft (open vault)

- No visible guardrail, covers, or installed fall arrest/rescue system mentioned or visible → No direct control found.

### Mobile equipment / traffic with workers on foot

- Hard physical barriers / work vehicles positioned to block traffic (stated): Targeted? Yes — barriers/vehicles directly prevent traffic incursion. Effective? Yes — highway-rated vehicles/barriers can stop vehicles with sufficient energy. Error-proof? Yes — once positioned they are passive barriers not requiring continuing human action.

### Electrical contact >50 V

- De-energized, verified, and grounded (stated): Targeted? Yes — directly removes electrical hazard. Effective? Yes — zero-voltage verification plus grounding mitigates stored charge and re-energization risk.

Summarizes results and makes recommendations...

# ChatSafetyAI



SAFETY AI

Error-proof? Yes — grounding and documented de-energization are persistent controls once completed.

Confined-space atmospheric hazard

- Air monitoring indicated no toxic chemical in vault (stated): Targeted? Yes — gas detection directly addresses atmospheric hazard. Effective? Yes — real-time monitoring detects hazardous atmospheres. Error-proof? Partly — detectors provide information but require correct placement, functioning, and response; as-installed monitoring can fail if not maintained, but presence of monitoring is an active control.

Crushing / pinch hazard from load landing

- Rigging and controlled lowering (rigging visible, crane control ongoing): Targeted? Yes — these controls reduce the risk of uncontrolled landing. Effective? Partly — depends on landing area preparation and exclusion zones. Error-proof? No — relies on correct operation and human actions to keep personnel clear.

Step 3. HECA Score Computation

High-Energy Hazard	Direct Controls
Heavy suspended load (transformer ~3000 lb)	Rigging (properly installed)
Moving/lowered load (lowering operation)	(Rigging/crane present but lowering is operator-dependent — not fully error-proof)
Fall from >4 ft (open vault opening)	No guardrail / fall arrest visible
Mobile equipment / traffic with workers on foot	Hard physical barriers / work vehicles blocking traffic
Electrical contact >50 V (transformer/cables)	De-energized, verified and grounded
Confined-space atmospheric hazard (vault)	Air monitoring (gas detection present)
Crushing / pinch hazard from load landing	(controls present but not error-proof / not fully demonstrated)

- Count of high-energy hazards = 7
- Count of directly controlled high-energy hazards = 4
- HECA Score (%) =  $100 \times 4 / 7 = 57.14\% \approx 57\%$

- Interpretation (one sentence): Over half of identified high-energy hazards have direct controls, but there remain critical exposures (fall, operator-dependent lowering, crushing) that need direct, error-proof controls to lower SIF potential.

## 👉 Recommendations

Provide a few highly relevant recommendations (one sentence each, max 6 recommendations in total).

- 💡 Install temporary rigid guardrail or cover over vault opening and/or use a certified fall-arrest/rescue system for personnel working at the edge.
- 💡 Establish and enforce a physical exclusion zone (hard barriers + spotter) around the suspended load landing area so no personnel are in potential crush zones.
- 💡 Use crane automatic load-hold/anti-drift features and a qualified signalperson to minimize operator-dependent lowering exposures; consider tag lines to control swing.
- 💡 Verify rigging certification documentation and use redundant load-retention devices (e.g., secondary slings or load restraint) while lowering over the vault.
- 💡 Maintain continuous calibrated atmospheric monitoring with alarmed remote readouts and rescue plan in place despite current "clear" readings.
- 💡 Ensure traffic-control barriers are highway-rated and documented; maintain lighting and high-visibility demarcation for night operations.

## ✿ Items to show on the photos:

scenario\_a\_eeyapevdzvgsrgi\_chatID=232.jpg: suspended load (transformer); open vault opening; ladder into vault; work vehicles / traffic barrier; workers at vault edge

scenario\_a\_1\_amrfrevnzyngiayg\_chatID=232.jpg: suspended load (transformer); crane boom/rigging; work vehicles / traffic barrier; workers near suspended load

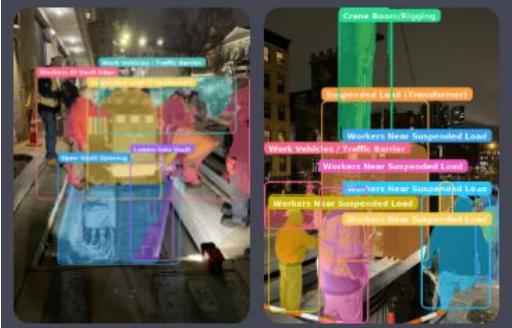
# ChatSafetyAI



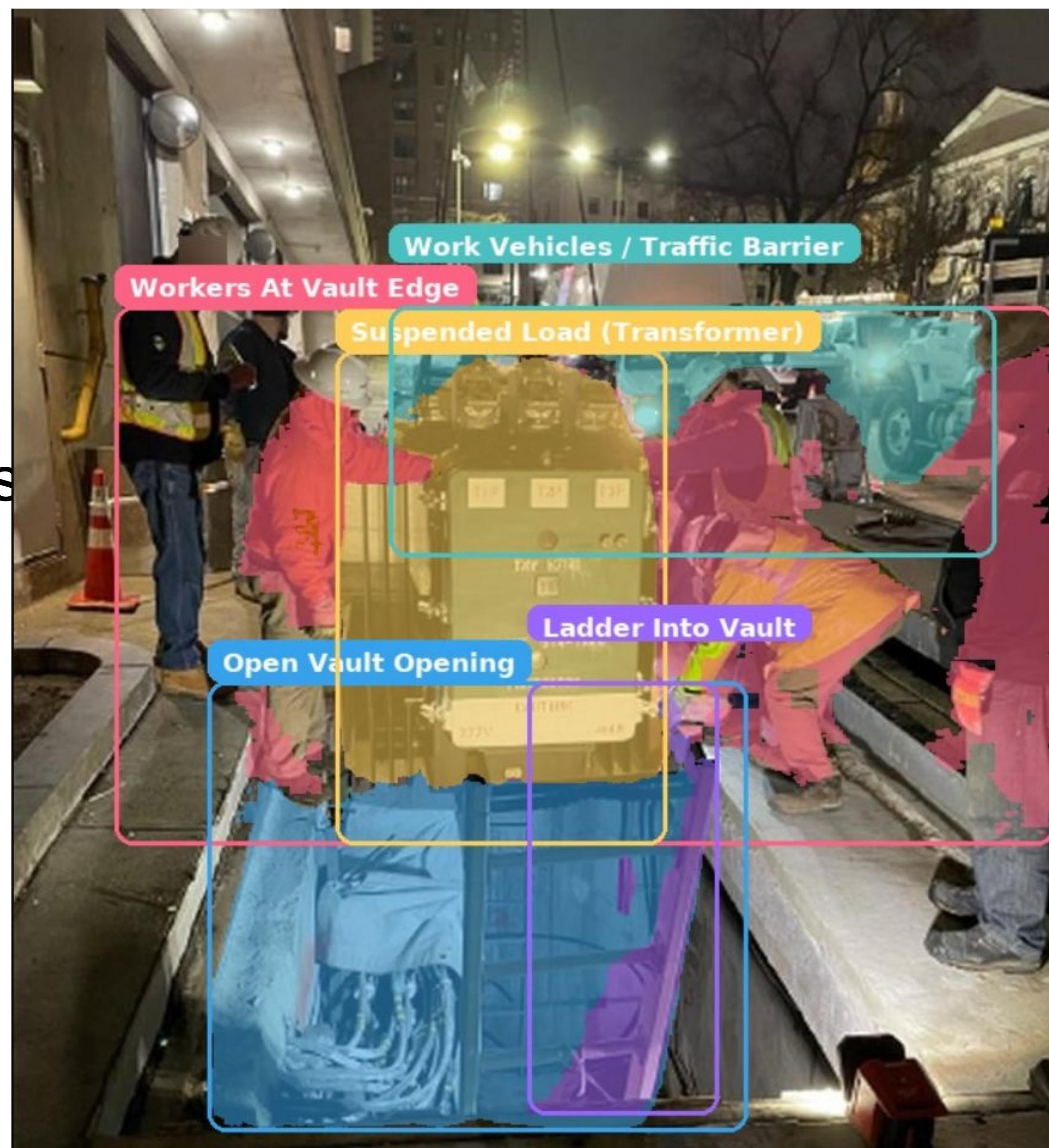
SAFETY A

Yellow warning icon: Maintain continuous calibrated atmospheric monitoring with alarmed remote readouts in place despite current "clear" readings.  
Blue info icon: Ensure traffic-control barriers are highway-rated and documented; maintain lighting and demarcation for night operations.

Yellow star icon: Items to show on the photos:  
scenario\_a\_eeyapevdzvgsrgi\_chatID=232.jpg: suspended load (transformer); open vault; work vehicles / traffic barrier; workers at vault edge  
scenario\_a\_1\_amfrevnzyngiayg\_chatID=232.jpg: suspended load (transformer); crane boom / rigging; work vehicles / traffic barrier; workers near suspended load



Finally, annotates relevant items in the photos ➤





Do a HECA (High-Energy Control Assessment) with the following info:

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- 1 am, temperature 30F
- Traffic is blocked by machinery and work vehicles that can handle the energy of traffic incursion
- Transformer is rigged properly
- Crane is not moving but the load is being lowered
- Air monitoring indicated no toxic chemical in vault

Thought for 34s >

Here's a HECA for this task.

## 1. Scope / Work snapshot

- **Task:** Replace pad-mounted transformer in 8-ft below-grade vault at street edge.
- **Time/conditions:** 0100 hrs, ~30°F, dark. 
- **Equipment:** Mobile crane, rigging, temporary traffic control, vault access/ladder

- **Equipment:** Mobile crane, rigging, temporary traffic control, vault access/ladder.
- **Load:** ~3,000 lb transformer, properly rigged, being **lowered** into vault (no crane travel).
- **Energization:** Vault de-energized, verified, grounded.
- **Atmosphere:** Monitored, no toxics indicated.
- **Traffic:** Roadway adjacent; work vehicles/machinery blocking lanes and capable of stopping traffic incursion.

## 2. High-Energy Sources & Magnitude

### 1. Gravity – suspended 3,000 lb transformer

- Potential energy from 8 ft: ≈ 32 kJ.
- Consequences: Crush/struck-by, vault structural damage, cable damage, fatal injuries.

### 2. Kinetic – load moving at ~4 mph while lowering

- Kinetic energy ≈ 2 kJ.
- Consequences: Struck-by if load swings; pinch between load, curb, vault frame.

### 3. Stored mechanical – crane, rigging & slings

- Line failure, rigging shift, boom or winch malfunction.

### 4. Fall hazard – 8-ft open vault

- Person or tools falling into vault.

### 5. Electrical – de-energized but present conductors

- Residual/induced energy, re-energization error, adjacent energized systems.

### 6. Traffic energy – adjacent street

- High-energy vehicle impact if controls fail/breached.

### 7. Environmental – cold, night work

- Reduced dexterity & grip, slips, fatigue, vis  ty.

### 3. Existing Controls (per info given)

- **Electrical:** Equipment de-energized, LOTO/verified, grounded.
- **Rigging:** Transformer rigged properly; crane stationary; load being lowered only.
- **Traffic:** Work vehicles/machinery physically blocking traffic, sized to absorb impact.
- **Atmosphere:** Air monitoring performed; no toxic chemicals indicated.
- **Access:** Ladder present in vault.

These are strong baseline controls but not sufficient alone for the energy levels present.

### 4. Gaps & Additional Controls Required

#### A. Gravity / Suspended load

- **Keep all workers out of line-of-fire:**
  - No one under the load or between load and vault edges/walls.
  - Assign one designated signal person in safe zone.
- **Lowering controls:**
  - Confirm slow, controlled descent; pause if alignment requires hands-on guidance—use tag lines, not body contact where possible.
- **Rigging verification:**
  - Second qualified rigger check of slings, shackles, hooks, capacities, sling angles, and attachment points before each lift.
- **Set-down stability:**
  - Confirm vault pad, supports, and shims are level and rated for weight before fully landing transformer.

#### B. Fall into 8-ft vault

- Guard the opening edges not used for the lowering path (portable railing, barriers).

#### B. Fall into 8-ft vault

- Guard the opening edges not used for the lowering path (portable railing, barriers).
- Require fall protection where workers lean over edge or work within 6 ft of unprotected sides, consistent with your fall-protection rules.
- Maintain 3-point contact on ladder; ladder secured and extending properly.

#### C. Crane / mechanical energy

- Pre-job inspection documented for crane and rigging.
- Operator and signal person use standard hand signals or dedicated radio channel; test comms.
- Exclusion zone around crane swing radius even though not slewing.

#### D. Electrical

- Verify LOTO permits and tags match this vault/transformer; test “dead” at point of work before grounding (already done, but reconfirm paperwork).
- Maintain barriers to any adjacent energized equipment/cables if present.
- Confirm grounds remain in place until all work complete.

#### E. Traffic

- Add cones/signage/taper and, if required by procedure, police detail or flaggers beyond the blocking vehicles.
- Ensure all workers inside barricaded work zone (no one standing in live lane).
- Check that blocking vehicles are in park, brakes set, wheels chocked where needed.

#### F. Atmosphere / Confined space

- Treat as permit-required confined space unless formally reclassified:
  - Verify O<sub>2</sub> level and combustible gas, not just toxics; continuous or periodic monitoring while occupied.
- Entrant/attendant roles defined; retrieval plan if someone is in the vault.

- No idling engines exhausting directly toward vault opening; manage ventilation as needed.

## G. Environmental (cold, dark, fatigue)

- Confirm adequate task lighting into the vault and around load path.
- Anti-slip footwear; clear ice/snow, grit slick surfaces.
- Warm-up breaks planned; monitor for fatigue given 0100 start.
- Gloves compatible with rigging work but warm enough for dexterity.

## H. PPE

- Hard hats, high-vis, safety boots, eye protection, appropriate gloves mandatory.
- Hearing protection if noise levels high.
- Consider cut-resistant gloves when handling cables/metal edges.

## 5. Go / No-Go Decision

### GO only if:

- Exclusion zones around the load, crane, and vault are established and enforced.
- Edge/fall protection and vault access are secured and inspected.
- Traffic control beyond simple vehicle blocking is in place per site standard.
- Rigging has been independently checked and documented.
- Electrical isolation/grounding and atmospheric tests are current and verified.
- Lighting, communication, and supervision are adequate for night work.

If any of these conditions are not fully met or cannot be maintained, NO-GO: stop the lift, make it safe, and correct the gap before resuming.

## Observations:

- Good output, but only follows the structure of a HECA at a very high level.
- After hazard and control identification, diverges to a long, general analysis very different from a focused HECA.
- No use or reference to direct controls whatsoever.
- Does not compute HECA score.
- Does not annotate photos.

# Gemini !

SAFETY AI



Do a HECA (High-Energy Control Assessment) with the following info:

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- Crane is not moving but the load is being lowered
- Air monitoring indicated no toxic chemical in vault

Results closely follow the structure and logic of a HECA (very good). This is consistent with the previous test (jargon) showing Gemini to be the only bot with ChatSafetyAI to know HECA.

Show thinking ▾

Based on the images provided and the data points listed, here is the **High-Energy Control Assessment (HECA)**.

This assessment focuses on identifying energy sources that have the potential to cause a fatality or serious injury (SIF) and verifying that direct controls are in place to contain that energy.

## 1. HECA Summary Matrix

Energy Source	Specific Hazard	High Energy?	Control Measure	Assessment Status
Gravity (Object)	Suspended Load (3,000 lbs)	YES	Proper Rigging, Crane capacity, Taglines	CONTROLLED (Verified by prompt/visuals)
Gravity (Person)	Fall into vault (8 ft drop)	YES	Situational Awareness (Rails removed for lift)	CRITICAL EXPOSURE (Requires vigilance)
Motion	Load Swing / Pinch Points	YES	Low speed (4 mph), PPE, Taglines	CONTROLLED
Electrical	High Voltage Contact	YES	De-energized, Verified, Grounded (DVG)	ELIMINATED
Mechanical	Traffic Incursion	YES	Barrier Vehicles (Blocking machinery)	CONTROLLED
Atmospheric	Oxygen/Toxins in Vault	NO	Air Monitoring	VERIFIED SAFE
Thermal	Cold Stress (30°F)	NO	Winter PPE, Warming breaks (implied)	MONITOR

However, results do not entirely comply with the HECA definitions:

Some controls listed are NOT direct controls (e.g., low speed, tagline).

👉 Motion of the load is NOT controlled.

👉 Traffic is motion, not mechanical.

# Gemini



SAFETY AI

## 2. Detailed Energy Analysis

### A. Gravity: The Suspended Load (3,000 lbs)

The transformer represents the most significant kinetic energy hazard in this scenario. Even at a slow movement of 4 mph (1.79 m/s), a 3,000 lb (1360 kg) load possesses significant kinetic energy.

$$E_k = \frac{1}{2}mv^2 \approx 2,178 \text{ Joules}$$

- **The Control:** The prompt confirms the rigging is proper and the crane is stationary.
- **Visual Evidence:** In the images, we see the use of a **tagline** (the rope held by the worker in the orange hoodie). This is a critical administrative control. It allows workers to guide the load without placing their hands directly on the suspended mass (Hands-Free lifting), keeping them out of the "Line of Fire" if the load shifts or drops.

### B. Gravity: Fall Hazard (8 ft Deep Vault)

An 8-foot fall is well above the OSHA trigger height (6 ft for construction) for fatal falls.

- **The Exposure:** In the images, the hard railings have likely been removed to allow the transformer to fit into the opening.
- **The Risk:** Workers are standing at the very edge of the void to guide the box.

- **The Risk:** Workers are standing at the very edge of the void to guide the box.

• **Control Assessment:** This is the highest residual risk area. Since physical barriers (rails) are temporarily removed, the crew is relying entirely on **Body Positioning and Footing**. The lighting (floodlights seen in the background) is crucial here to prevent tripping into the vault.

### C. Electrical Energy

- **The Control:** The system is **De-energized, Verified, and Grounded**.
- **Assessment:** This is the gold standard of electrical safety. By grounding the system, you create an equipotential zone, ensuring that even if the line were accidentally re-energized, the voltage difference across a worker's body would be minimized, tripping the upstream breaker immediately.

### D. Mechanical: Traffic Incursion

- **The Hazard:** Working on a street at 1 AM places the crew at risk from drunk or drowsy drivers.
- **The Control:** The prompt states traffic is blocked by machinery capable of handling the energy.
- **Assessment:** Using a "blocker vehicle" (like a heavy utility truck or dump truck) positioned upstream of the work zone is an effective physical barrier. It absorbs the energy of a crashing vehicle so the workers in the vault do not.

## 3. Human Performance Factors (The "X" Factor)

While the physical energies are controlled, the environmental factors introduce **Human Performance (HU)** error traps:

- **Time of Day (1 AM):** Circadian rhythms are low. Reaction times are slower, and situational awareness decreases.
- **Temperature (30°F):** Cold stress can reduce manual dexterity (numb fingers) and cause rushing to finish the job sooner.
- **The "Rushing" Trap:** Combining 1 AM fatigue with freezing temperatures creates a high psychological pressure to cut corners to get warm/home.

**Note on Line of Fire:** As seen in the diagram above, ensuring workers are never positioned between the load and an immovable object (the vault wall or the truck) is vital. In Image A, the workers are very close to the pinch points.

## 4. Final Determination

**Result: PROCEED WITH CAUTION**

The High-Energy controls are in place (DVG, Traffic Blockers, Rigging). However, the **fall hazard** (open vault) and **pinch points** (guiding the load) rely heavily on worker behavior rather than engineering controls.

- Hallucinates the presence of a tagline, which is not a direct control anyway.
- The motion energy computation is very good, but is listed under "Gravity". Also, it's not needed here, as the suspended transformer is clearly HE for both motion and gravity.
- Human factors section: interesting, but out-of-scope for HECA, per definition.
- Does not compute HECA score. Does not annotate photos.



**A** Do a HECA (High-Energy Control Assessment) with the following info:

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## High-Energy Control Assessment (HECA)

### Transformer Replacement Operation

Date/Time: 1:00 AM, 30°F

Location: 8 ft deep vault adjacent to traffic

Operation: Lowering 3,000 lb transformer into vault

### IDENTIFIED HIGH-ENERGY HAZARDS

#### 1. GRAVITATIONAL POTENTIAL ENERGY ⚠ PRIMARY HAZARD

- Energy Level:  $3,000 \text{ lbs} \times 8 \text{ ft} = 24,000 \text{ ft-lbs}$  of potential energy
- Consequences: Crushing, fatal injuries if load falls or swings
- Exposure: Workers in/around vault, personnel guiding load

#### Controls in Place:

- Proper rigging verified ✓
- Controlled lowering (4 mph = controlled speed) ✓

#### Additional Controls Needed:

- Exclusion zone around load path - NO personnel directly under suspended load
- Tag lines to control load swing/rotation
- Dedicated spotter monitoring load descent
- Pre-lift rigging inspection documented
- Crane operator certification verified
- Load capacity margin confirmed (crane rated for >3,000 lbs)

#### 2. KINETIC ENERGY - Traffic

- Energy Level: Vehicles at street speeds (25-45 mph, 3,000+ lbs)
- Consequences: Worker struck-by, equipment damage, loss of work zone

#### Controls in Place:

- Traffic blocked by machinery and work vehicles ✓

- Vehicles positioned to absorb impact energy ✓

**Additional Controls Needed:**

- Verify blocking vehicles are properly positioned and adequate mass
- High-visibility barriers, signs, and advance warnings
- Dedicated traffic spotter if any lanes open
- Reflective gear on all personnel (critical at 1 AM)

### 3. ELECTRICAL ENERGY ⚠ CRITICAL - VERIFY BEFORE PROCEEDING

- **Energy Level:** Potentially lethal (transformer voltage typically 4kV-35kV)
- **Consequences:** Electrocution, arc flash, blast

**Controls in Place:**

- Vault de-energized ✓
- Verified and grounded ✓

**CRITICAL Verification Required:**

- Lockout/Tagout (LOTO) procedures documented and verified
- Testing performed with rated voltage detector
- Grounding locations and adequacy verified
- Adjacent energized equipment identified and barriers in place
- Approach distances to any remaining energized equipment maintained  
↓
- All personnel trained on electrical hazards present

### 4. CONFINED SPACE HAZARDS

- **Space Characteristics:** 8 ft deep vault = permit-required confined space
- **Hazards:** Atmospheric (oxygen, toxic gases), engulfment, fall

**Controls in Place:**

- Air monitoring - no toxic chemicals detected ✓

**Additional Controls Needed:**

- **Continuous** atmospheric monitoring (O<sub>2</sub>, LEL, H<sub>2</sub>S, CO minimum)
- Confined space entry permit completed
- Attendant positioned at vault entrance
- Retrieval system for personnel in vault
- Communication system established
- Emergency rescue plan and equipment ready
- Entry-level personnel vs. descent depth managed

### 5. ENVIRONMENTAL - Cold Stress

- **Conditions:** 30°F at 1 AM
- **Consequences:** Reduced dexterity, fatigue, hypothermia, impaired judgment

**Controls Needed:**

- Warm break area available
- Appropriate cold-weather PPE



- Frequent warming breaks

- Hydration available
- Monitor workers for cold stress symptoms
- Reduced work duration considerations

### 6. HUMAN FACTORS - Fatigue/Night Work

- **Conditions:** 1 AM operation
- **Consequences:** Reduced alertness, slower reaction time, errors

**Controls Needed:**

- Enhanced lighting around work area and vault
- Frequent communication checks
- Pre-job safety brief
- Adequate crew size to avoid rushing
- Clear role assignments

### 7. SECONDARY HAZARDS

**Slip/Trip/Fall:**

- Vault opening creates 8 ft fall hazard
- Ice potential at 30°F
- Barriers around vault perimeter



- Edge protection if workers approach opening
- Anti-slip surfaces/treatments

#### Struck-By (Equipment):

- Crane boom movement
- Exclusion zone enforcement
- All personnel maintain visual contact with operator

#### Pinch Points:

- Transformer/rigging contact points
- Hand protection required
- Keep hands clear during final positioning

## CRITICAL CONTROL SUMMARY

#### STOP WORK if:

1. Suspended load over personnel
2. Electrical verification incomplete or questionable
3. Atmospheric monitoring shows unsafe levels
4. Rigging shows damage or inadequacy
5. Traffic control compromised
6. Weather deteriorates (ice, high wind)

#### Communication Protocol:

- Dedicated radio channel
- Hand signals established for crane operations
- Emergency contact numbers posted
- Hospital route identified

#### Energy Isolation Verification:

- Zero-energy state confirmed before entry
- Test equipment functioning properly
- Grounds visible and adequate

#### RECOMMENDATION

##### Proceed with operation IF:

- All controls listed above are in place and verified
- Personnel briefed on energy hazards and emergency procedures
- Permits (electrical LOTO, confined space entry) completed and posted
- Emergency equipment staged and tested

This is a HIGH-RISK evolution combining multiple high-energy sources. Safe compliance and continuous hazard monitoring are essential.

Very similar to ChatGPT:

- Good output, but soon diverges to a long, general analysis that never mentions direct controls.
- Misses the motion energy of the suspended load.
- Includes non HE hazards (e.g., ambient temp) and human factors, both out of scope for HECA).
- Does not compute HECA score.
- Does not annotate photos.

# HECA II

SAFETY A

This time, just a photo without any additional information:

“Do a HECA of this scene”



# ChatSafetyAI



SAFETY AI

Asks clarification questions before proceeding, to avoid guessing.



Do a HECA of this scene

A To complete a solid HECA for this scene, I need a bit more information from you:

1. Are the overhead power lines currently energized or de-energized?
2. Are there any additional workers or equipment out of frame (e.g., behind the trucks or in the bucket)?
3. Are there physical barriers in place to prevent unauthorized entry into the work zone (e.g., rigid barricades, cones with chains, fencing), or just caution tape?
4. Is the worker in the bucket using fall protection (full-body harness with lanyard or lifeline tied off correctly)?

Once you confirm these, I'll walk through the high-energy hazards, direct controls, exposures, and give you a HECA score.

A Here are additional details:

- Task: fixing broken electric pole.
- Road is closed to traffic with cones and signs
- Line is de-energized with zero voltage test
- Two workers are in buckets and are both wearing proper fall protection
- A worker is sitting on the foreground truck's bed to operate the boom

(Showing final summary table only, for brevity)

High-Energy Hazard	Direct Controls
Person in elevated bucket working on pole (potential fall >4 ft – gravity)	<input checked="" type="checkbox"/> Fall arrest system (harness and lanyard)
Bucket trucks with booms extended creating tip-over / collapse potential	<input checked="" type="checkbox"/> Outriggers/stabilizers on bucket truck
Ground worker on foot close to bucket trucks and moving booms	<input checked="" type="checkbox"/>
Worker sitting on elevated truck bed while operating boom controls	<input checked="" type="checkbox"/>
Overhead distribution power lines capable of being energized >50 V	<input checked="" type="checkbox"/> De-energization with zero-voltage test
Public roadway where errant vehicle could enter work zone	<input checked="" type="checkbox"/>
Heavy pole hardware and conductors suspended at height above workers	<input checked="" type="checkbox"/>

- Count of high-energy hazards = 7
- Count of directly controlled high-energy hazards = 3
- HECA Score (%) =  $100 \times 3 / 7 \approx 42.9\%$

- **Interpretation:** Several critical high-energy hazards are directly controlled, but there remain multiple uncontrolled exposures for workers on the ground and from traffic and dropped objects.

## 👉 Recommendations

- 💡 Add hard-barrier exclusion around the swing radius of the booms (e.g., rigid barricades or guardrails) to separate ground workers from moving equipment.
- 💡 Provide fall protection or redesign the task so the worker operating boom controls is not required to sit or stand on an unprotected truck bed edge.
- 💡 Upgrade traffic protection by using work vehicles as physical blockers and/or portable barriers in addition to cones and signage to resist vehicle intrusion.
- 💡 Establish and barricade a clearly defined drop zone under the pole with hard barriers, and keep non-essential personnel outside that zone.
- 💡 Reconfirm and document the de-energized status with proper lockout/tagout where applicable and maintain visible grounds if required by your procedures.



ChatSafetyAI vs Others,  
Antoine Tixier,  
[www.safetyai.io](http://www.safetyai.io)



Do a HECA (High-Energy Control Assessment) of this scene. Provide a summary table at the end.

Below is a focused HECA (High-Energy Control Assessment) for the scene.

#### High-Energy Sources Present

##### 1. Overhead electrical lines

- Energized conductors overhead.
- Worker in bucket near lines = high electrocution and arc-flash potential.

##### 2. Elevated work / bucket trucks

Expanded HECA acronym to be fair, and asked for summary table at the end, for brevity and comparison purposes (same for Gemini and Claude).

## Summary Table

Hazard Category	High-Energy Source	Current Controls	Needed Controls
Electrical	Overhead energized lines	PPE, bucket equipment	De-energize/insulate lines, arc-flash PPE
Elevated Work	Bucket lifts	Outriggers	Marked drop zone, spotter
Heavy Equipment	Trucks, hydraulics	Stabilization, PPE	Strict exclusion zones
Traffic	Roadway exposure	Caution tape	Cones, signs, barriers
Tools	Chainsaw on ground	Set aside	Secure storage, housekeeping

If you want, I can turn this into a formal HECA worksheet.





Do a HECA (High-Energy Control Assessment) of this scene.  
Provide a summary table at the end.

Show thinking ▾

Based on the image provided, here is a **High-Energy Control Assessment (HECA)**.

This assessment focuses on identifying high-energy sources (Gravity, Motion, Electrical, Pressure, etc.) that could cause Serious Injury or Fatality (SIF) and evaluating the controls visible in the scene.

## HECA Summary Table

Energy Category	Specific Hazard	Status	Visible/Implied Controls	Critical Recommendations
<b>Gravity</b>	Fall from bucket	<b>Active</b>	Bucket enclosure, Outriggers deployed.	Ensure 100% tie-off (harness); Verify outrigger pads are used if ground is soft.
<b>Electrical</b>	Contact with live lines	<b>Critical</b>	Insulated boom/bucket; Worker PPE (Hard hat).	Verify rubber gloves/sleeves; Ensure truck grounding is established.
<b>Motion</b>	Struck by traffic	<b>Active</b>	Cones, Caution tape, Hi-Vis vests.	Ensure a "Spotter" is designated to watch traffic/pedestrians.
<b>Mechanical</b>	Struck by dropped object	<b>Active</b>	Hard hats worn by ground crew.	Clear the area directly under the bucket (Drop Zone).
<b>Mechanical</b>	Chainsaw injury/Trip	<b>Latent</b>	None (Tool is on the ground).	<b>Housekeeping:</b> Secure the chainsaw; do not leave tools in walking paths.



A Do a HECA (High-Energy Control Assessment) of this scene. Provide a summary table at the end.

## High-Energy Control Assessment (HECA)

### Scene Overview

Utility line maintenance/repair work being performed from an elevated bucket truck in a residential area.

### Identified High-Energy Hazards

#### 1. ELECTRICAL ENERGY

- Hazard:** Overhead power lines (primary distribution, likely 7.2-34.5 kV)
- Exposure:** Workers in aerial bucket in direct proximity to energized conductors
- Controls Identified:**

## HECA SUMMARY TABLE

Hazard Category	Energy Level	Primary Controls	Residual Risk	Priority
Electrical Contact	CRITICAL	Insulated equipment, PPE, distance	MEDIUM-HIGH	1
Falls from Height	HIGH	Bucket platform, fall protection	MEDIUM	2
Weather/Lightning	HIGH	Weather monitoring, work stoppage	MEDIUM-HIGH	1
Vehicle Strikes	MEDIUM	Hi-vis clothing, work zone, tape	MEDIUM	3
Crushing (Equipment)	MEDIUM	Outriggers, barriers, communication	LOW-MEDIUM	4
Hydraulic Failure	MEDIUM	Maintenance, inspection	LOW	5

**Overall Risk Rating:** MEDIUM-HIGH (primarily due to electrical exposure and weather conditions)

**Work Stoppage Triggers:** Lightning within 6 miles, equipment failure, loss of traffic control, PPE deficiency

- Results are quite good, but...
- When no additional text information is provided, the relevance of the HECA produced significantly decreases, even for Gemini, which knows what HECA is (see jargon experiment)
- No model asks clarification questions before proceeding, resulting in assumptions being made
- No model considers high energy only
- No model mentions or considers direct controls only
- No model annotates the photos
- Gemini is slightly better than ChatGPT and Claude (e.g., noticed the chainsaw in the foreground - not HE hazard, though)

# Results Summary

SAFETY 

	ChatSafetyAI	ChatGPT	Gemini	Claude
Anonymization				
Guardrails				
Energy Knowledge				
Visual Hazard Recognition				
Visual Energy Recognition I				
Visual Energy Recognition II				
Jargon				
HECA I				
HECA II				
<b>TOTAL POINTS</b>	<b>9</b>	<b>0.5</b>	<b>3</b>	<b>1.5</b>

# Main Takeaways

- ChatGPT, Gemini and Claude all perform well out of the box, but they sometimes lack niche knowledge, miss specific details, or are unable to perform some tasks (e.g., properly annotate photos).
- None of them anonymize inputs or reject queries unrelated to work.
- Their behavior is unstable (e.g., sometimes accept to annotate photos, sometimes reject, constantly change their response format).

👉 To achieve the best possible results, ChatGPT, Gemini and Claude would benefit from some form of customization: *guardrails, extra knowledge, focused instructions and clear rules, integration with external models*.

👉 **This is precisely what ChatSafetyAI does.**

These experiments illustrate well how adding a layer of customization between the off-the-shelf chatbots from the main LLM providers and the end users can optimize the output in a specific domain.

# Main Takeaways

- Moreover, being based on both the GPT and Gemini LLMs (or Claude when deployed in-house), ChatSafetyAI capitalizes on their respective strengths.
- 👉 All of this explains why ChatSafetyAI performs best in all experiments 🏆
- Finally, regardless of ChatSafetyAI, it is interesting to note that Gemini is better than both Claude and ChatGPT, while Claude has a slight edge over ChatGPT.



# Thank You!

Try ChatSafetyAI, read our papers, watch screencast demos, subscribe to our newsletter, and more, at: [www.safetyai.io](http://www.safetyai.io)



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