# Marsh

## Process Safety Risks in Renewable Energy May 11, 2022

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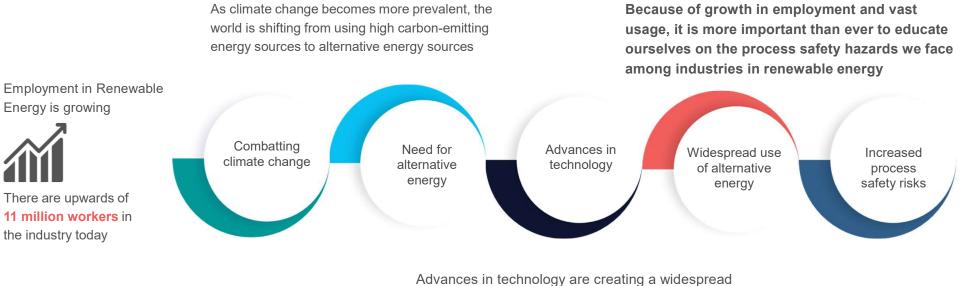
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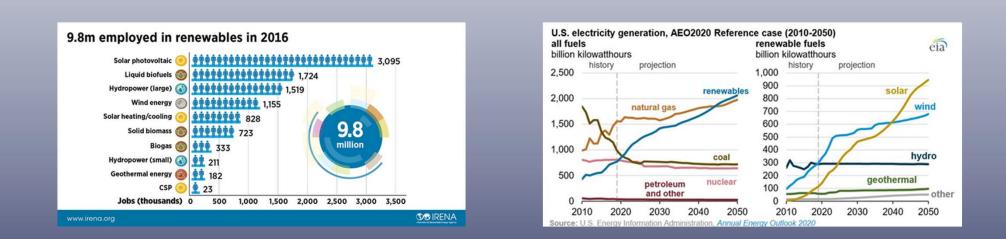
## Why is this important?



use of renewable energy sources

## **Trends**

The EIA predicts that by 2050, **renewables will make up 27% of primary energy consumption** largely due to new technologies that will make renewable energy more cost effective

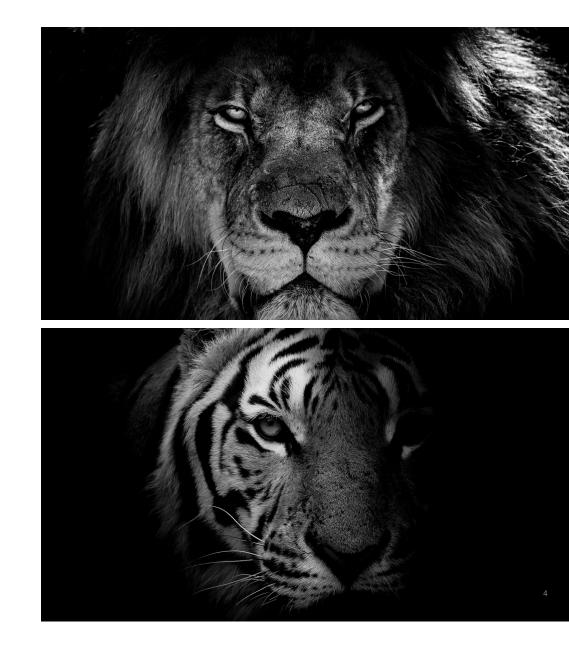


"Green jobs do not necessarily mean that they are safe jobs." - OSHA

Green Job Hazards | Occupational Safety and Health Administration (osha.gov)

What are the differences between a lion and a tiger?

What are the similarities between a lion and a tiger?



The Lion – Personal Safety	Hunts in groups
Personal Salety	Is visible
	Is loud
	Is a killer
	Can never be fully tamed
	Can never be left unguarded
	Needs constant attention

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The Tiger – Process Safety	Hunts alone		
Process Salety	Is invisible		
	Is silent		
	ls a killer		
	Can never be fully tamed		
	Can never be left unguarded		
	Needs constant attention		© JMJ

## **Solar Energy Safety Risks**

#### **Process Safety**



Fire Hazards





**Roof Collapse** 





Electrical hazards

### Personal Safety

Falls / Lifting





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Heat

#### **Preventions in Place:**

Verify roof and fall protection integrity

Arc Fault

Lock out electrical energy

#### **Notable Incidents**

Typically, these incidents are single fatalities cased by falls from heights. In 2020 the US experienced 200 fatalities from this type of incident. 6% of roofs have solar panels and this is expected to grow to 15% by 2025. We can extrapolate that solar installation fatalities will also more than double in that period.

OSHA has identified exposure to Cadmium Telluride, a known carcinogen.

Evidence: In 2016, 849 fatalities were reportedly caused by falls, 170 due to ladders. In 2017, 39.2% of fatalities in construction were due to falls. A reported incident occurred in 2018 when a worker was installing solar panels and fell 15 feet onto the pavement, injuring his jaw and wrist. A proper fall arrest system in place could have prevented his injuries OSHA data indicates personal safety performance ranges from a TRIR of 0.2 all the way up to 33.3!

## Wind Energy Safety Risks

#### **Process Safety**





**Preventions in Place:** 

Frequent blade maintenance



Identify where and why fires happen; quick descent device tools

Transferring crew to offshore site

Safe transport from ships to off-shore wind assets



Construction of turbines - cranes and weather

conditions

#### **Personal Safety**



Falling / Lifting at



Electric shock



Low oxygen in

confined spaces



Crush and

pin-points

Blade Failure

## Fire hazards

## heights

#### **Notable Incidents**

- Defects in gearboxes, bearings, and blades
- Turbine fires
- Structural failures

- Arson and terrorism
- Lightning, ice, thermal cycling, moisture intrusion
- Other natural catastrophes

Blade failure is the most common failure associated with wind energy. There are roughly 3,800 reported accidents each year. Since 1996, there have been 220 fatalities.



#### **Preventions in Place:**

- Maintenance protocols and inspection
- Design integrity
- Emergency crisis mitigation management
- Chemical monitoring

#### **Notable Incidents**

- Destruction due to water in power stations
- Overtopping due to landslides
- Flooding with climate extremes
- Poor construction, aged facility and neglect causing failure even in fair weather
- Spillway failure

Sudden breaching of a saddle dam on July 23, 2018, on the perimeter of the Xe Nammoy hydroelectric-power reservoir, recently constructed in the Mekong basin, southern Laos, caused catastrophic flooding that resulted in fatalities and displaced thousands of individuals.

## Geothermal Energy Safety Risks

**Personal Safety** 

#### **Process Safety**





Design and mechanical integrity failures

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Heat and high pressure

Welding and cutting hazards



Confined

space







Trenching and

excavating



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Exposure to chemicals and toxic gases

#### **Preventions in Place:**

Well established safety policies on heat and high-pressure hazards

#### **Notable Incidents**

- Various incidents and deaths from improper shoring in trending work
- Chemical releases such as Hydrosulfide causing serious incidents

Rotating

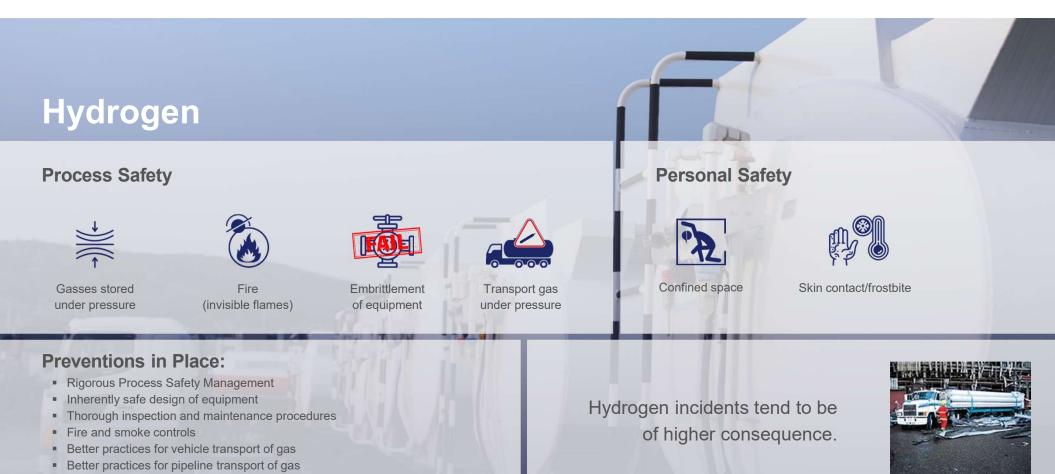
machinery

 Geothermal leaks of high temperature causing hazardous conditions and accidents

## **Biomass Energy Safety Risks**



In a study done on the fire and explosion risk of biodiesel plants, there were a total of 61 events with 68 injuries and 21 fatalities identified. The number one cause of accidents identified was due to component failure.



Emergency and crisis management

Safety requirements for industrial uses of hydrogen are well established. The National Fire Protection Association (NFPA) and the Compressed Gas Association (CGA) have published safety standards that address the storage, use, and handling of hydrogen in industrial applications that date back to the first edition of NFPA 567 (later renumbered as NFPA 50A) (National Fire Protection Association 1963) circa 1960.

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#### **Process Safety**







Fire from Explosion thermal runaway

Toxic Gases

Disposal hazards

#### **Personal Safety**



Battery handling, storage and incidental damages



Electrical hazards

#### **Preventions in Place:**

- Fire detection and suppression
- Emergency response, central alarm monitoring
- Gas monitoring and ventilation
- Control system/battery monitoring (e.g., current/voltage monitoring)
- Protect the battery casing/connections from damage
- Keep batteries from contacting conductive materials
- Implement verification processes



In 2019 a site in Surprise, Arizona experienced a catastrophic failure caused by a single rack of modules. The fire did not spread, although after the suppression agent was discharged, a mixture of explosive gases built up in the container was ignited by an undetermined source, resulting in an explosion.

Lithium Ion is susceptible to fires under certain conditions. One of the more serious hazards is an internal failure of battery cells leading to a short circuit that generates heat and causes "thermal runaway." When thermal runaway occurs, the fire moves through an entire module, unless the batteries are adequately cooled and isolated.

## An Industry Warning; learn from other industries' history or be doomed to repeat it!

- A new and evolving industry with limited understanding of risks within the field
- Insufficient Board and leadership focus upon safety
- Pressure for financial performance at the expense of safety performance
- New organizations lack safety management systems and requirements
- Rapid growth places pressure on construction schedules
- Misalignment with contractors on safety requirements
- New equipment and technology is being introduced to inexperienced workers

## Our Responsibilities; As renewables take a greater place in our world



Board, Executive and Line leader awareness and understanding



Recognize and understand the hazards and risks



Rapidly adopt learnings from other industries

## Path Forward: What are steps the industry can take

Proper safety analysis at commissioning of project as well as throughout- be ahead of the game when new risks are introduced because of new tasks

Develop practices for a strong safety culture

Improved maintenance practices Consistent and rigorous operator training

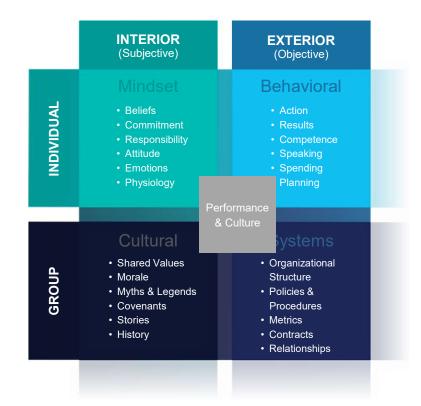
Increased knowledge and research

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Two Sides of the Same Coin

Marsh's Three Pillars represents the way to manage safety across an enterprise



JMJ's Integral Model describes components of safety culture

## Summary: Most Common Personal and Process Safety Risks by Renewable Type

Most renewable energy risks are personal safety however, process safety should not be ignored								
		由	3	<u>La</u>				
	Solar	Wind	Hydroelectric Power	Geothermal	Biomass			
Process satety	<ul> <li>Fire Hazards</li> <li>Arc Fault</li> <li>Roof collapse</li> <li>Electrical hazards</li> </ul>	<ul> <li>Blade Failure</li> <li>Rescue - transferring crew to offshore site</li> <li>Fire hazards</li> <li>Construction of turbines- Cranes and weather conditions</li> </ul>	<ul> <li>Blasting and Cave-ins</li> <li>Rockslides and avalanches</li> <li>Overtopping / Dam Failure</li> <li>Electrical hazards</li> <li>Chemicals (SF6, HSF, etc.)</li> <li>Hazardous Products</li> </ul>	• Design and mechanical integrity failures	<ul> <li>Fire hazards</li> <li>Risk of dust explosion</li> </ul>			
reisolial Salety	<ul> <li>Falls / Lifting</li> <li>Electric shock</li> <li>Ergonomics</li> <li>Heat</li> </ul>	<ul> <li>Falling / Lifting at heights</li> <li>Electric shock</li> <li>Low oxygen in confined spaces</li> <li>Crush and pin-points</li> </ul>	<ul><li>Trips, slips, falls</li><li>Ergonomics</li><li>Drowning</li></ul>	<ul> <li>Heat and high pressure</li> <li>Welding and cutting hazards</li> <li>Confined space</li> <li>Rotating machinery</li> <li>Trenching and excavating</li> <li>Exposure to chemicals and toxic gases</li> </ul>	<ul> <li>Exposure to chemicals, dust, molds and fungi</li> <li>Machinery hazards, rotating equipment</li> <li>Motor vehicle accidents</li> <li>Trips, slips, falls</li> <li>Motor vehicle accidents</li> </ul>			

# Citations and References: **Special thanks to**

Purdue students Joaquin Herrero & Caroline Morgan And their 2021 research paper "Process Safety Hazards of Alternative Energy"

B. WARNER

# Thank you for your time

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