# *Fire hazards and risk mitigation strategies of alternative energy solutions*

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Fire & Risk Alliance, LLC.

# *Workshop Schedule – Day 2*

9:45 am to 10:45 am – Introductions and small group work
10:45 am to 11:00 am – Break
11:00 am to 12:00 pm – Small group work continues
12:00 pm to 1:00 pm – Lunch
1:00 pm – reconvene in the main lecture room
1:00 pm to 2:00 pm – Workshop facilitators present findings
(of their small groups)

# *Workshop / Group Activities (Day 2)*

1 hour – Introductions and small group work

Facilitator introduces the “contemporary issue”

Attendee introductions

Case and Ecosystem discussion

15 min – Break

1 hour – Small group work continues

Facilitator records small group recommendations

1 hour – Lunch

# *Workshop / Group Goals (Day 2)*

Introduce yourself to each other
(Current job, location, role(s) within the NFPA Ecosystem, why interested in this topic)

Discuss the contemporary issue

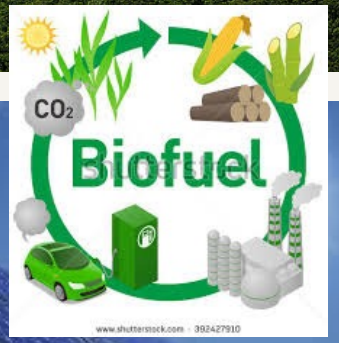
Identify challenges / recent failures

Identify what elements of the NFPA Ecosystem may have been lacking (under-represented) in recent failures

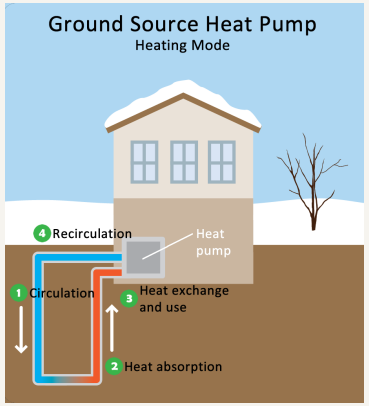
Identify ways the NFPA Ecosystem may help in the future

# *What is Alternative Energy?*

# *Alternative Energy*

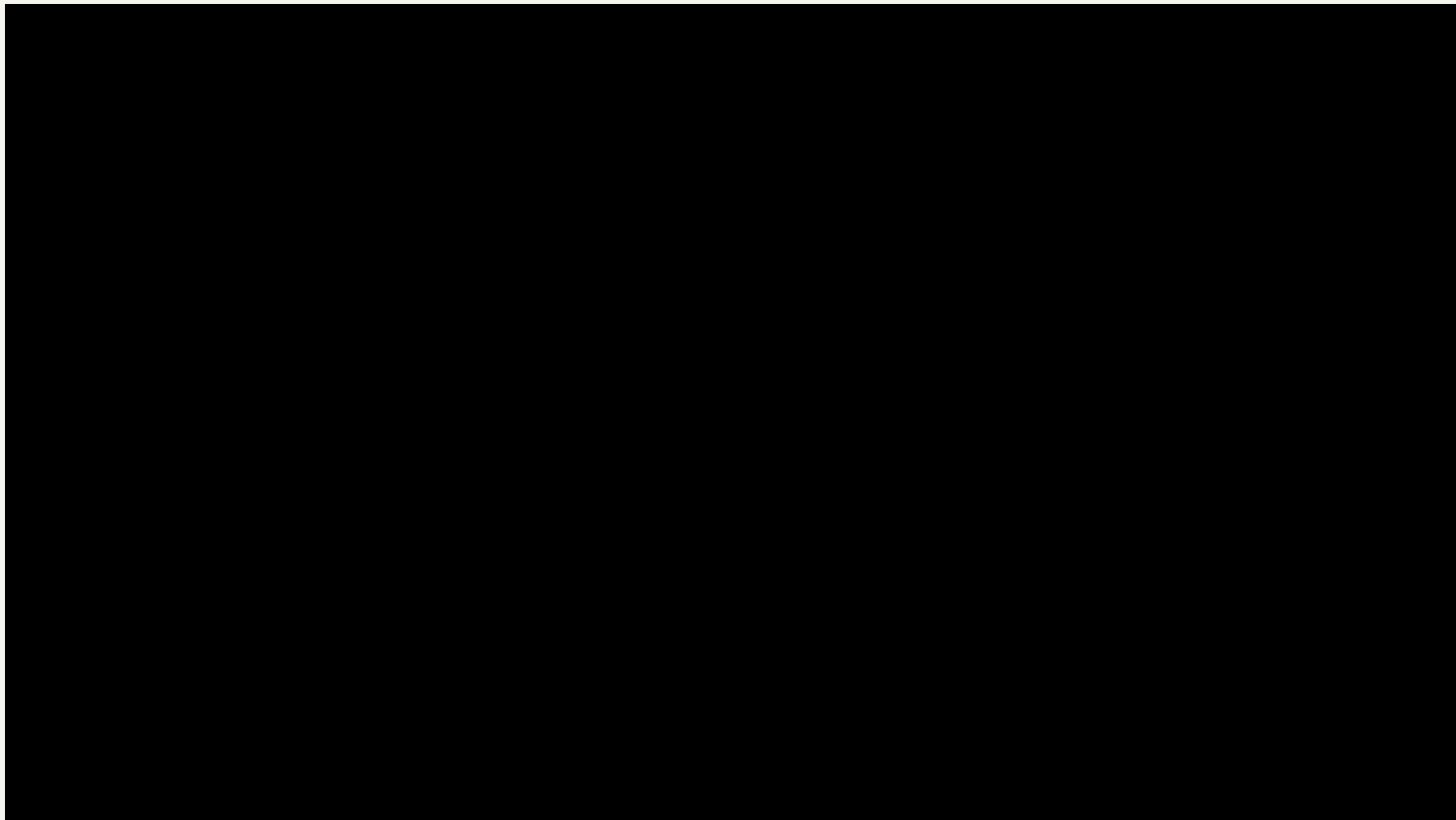





# *Wind Energy*

- Wind turbines operate on a simple principle. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity.



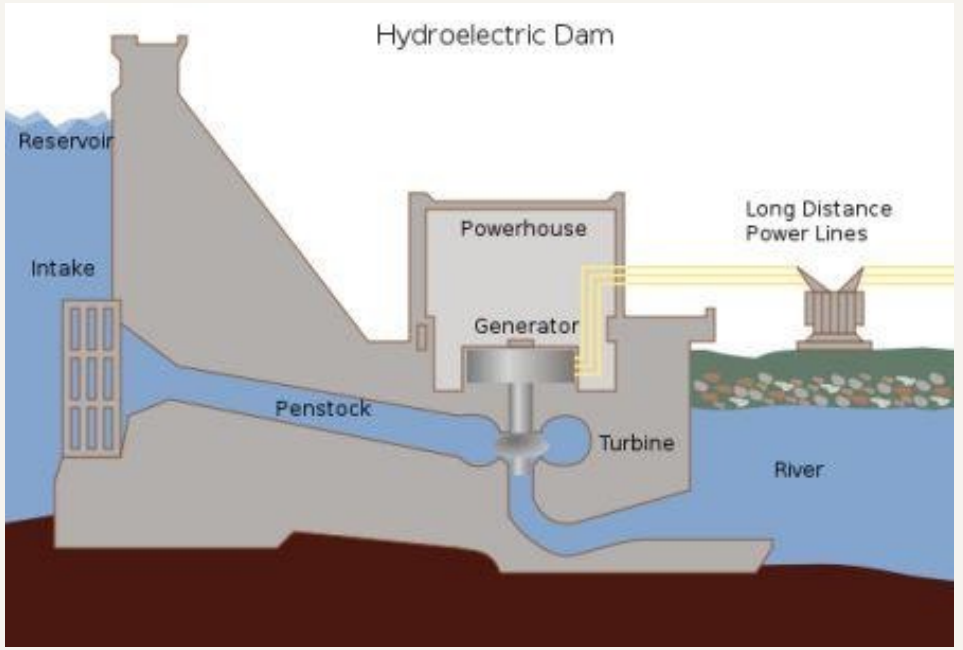
# *Tidal Energy*

- Tidal Stream Generator

  *Makes use of the kinetic energy of moving water to power turbines, in a similar way to wind turbines that use wind to power turbines.*

- Tidal Barrage

  *Tidal barrages make use of the potential energy in the difference in height between high and low tides.*



# *Wave Energy*

- Ocean waves contain tremendous energy potential.
- Wave power devices extract energy from the surface motion of ocean waves or from pressure fluctuations below the surface.

# *Geothermal Energy*

- (geo = earth and thermal = heat), geothermal energy comes from heat produced by the Earth.

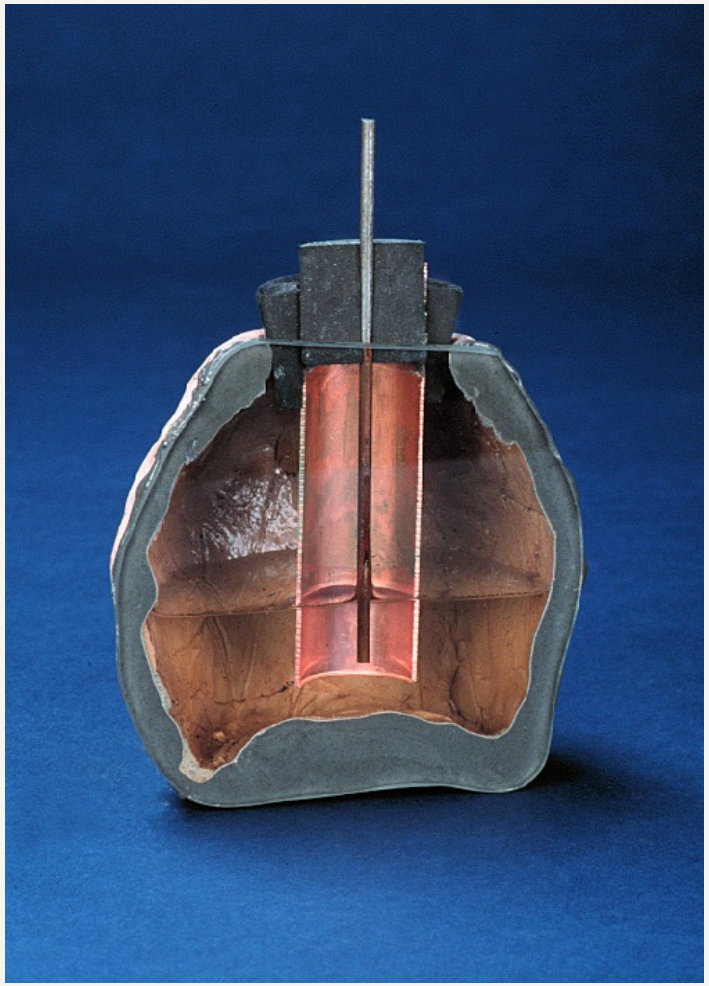
# *Biofuels*

- The two most common types of biofuels are **ethanol** and **biodiesel**.


# *Solar Energy*

# *What's the Common Thread?*

# *Energy Storage Not New*



# *Energy Storage Technologies*

## Chemical

- Ammonia
- Hydrogen
- Drop-in Fuels
- Methanol
- Synthetic Fuels Gas
- Synthetic Natural Gas

## Electrochemical

### Classic Batteries

- Lead-Acid
- Li-ion
- Li-Polymer
- Li-S
- Na-NiCl2
- Na-Ion
- Na-Cd
- Na-S

### Flow Batteries

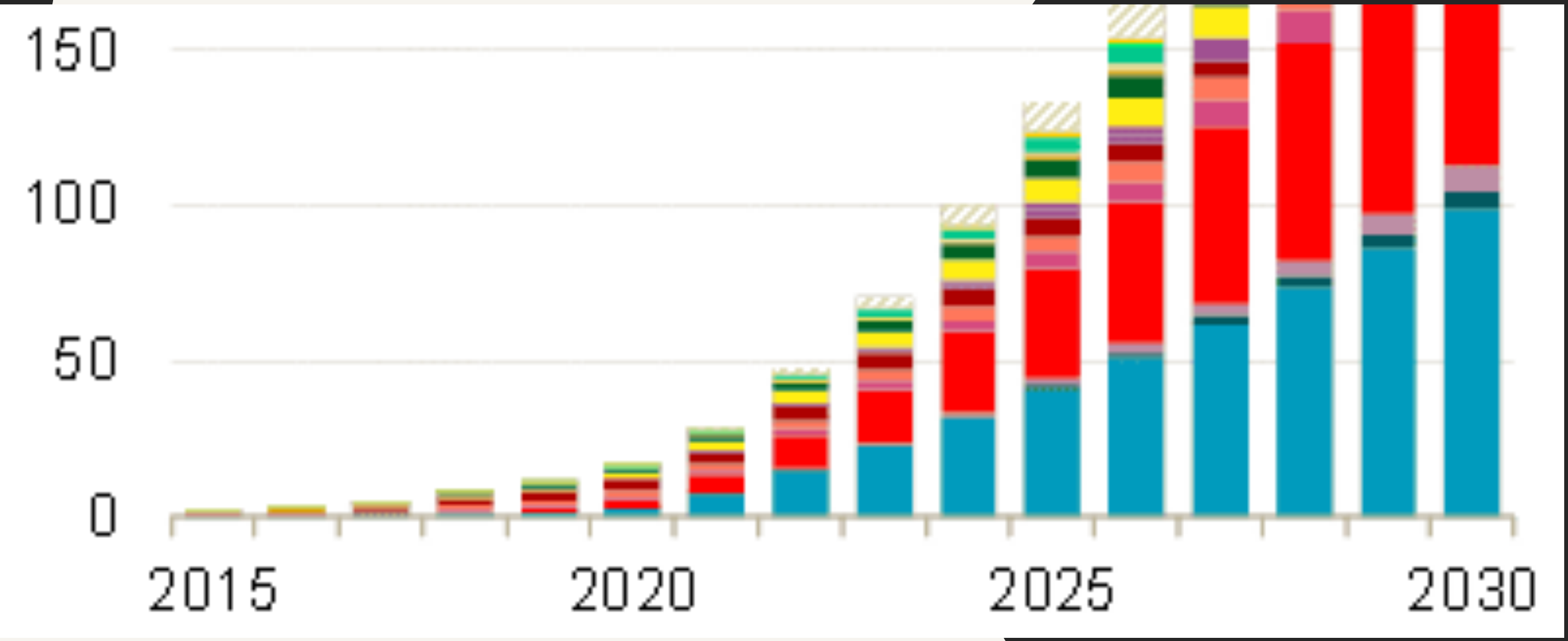
- Vanadium Red-Ox
- Zn-Br
- Zn-Fe

## Electrical

- Supercapacitors
- Superconducting Magnetoc Energy Storage (SMES)

## Mechanical

- Compressed Air
- Flywheels
- Gravity
- Liquid Air
- Pumped Hydro
- Column Stack


150
100
50
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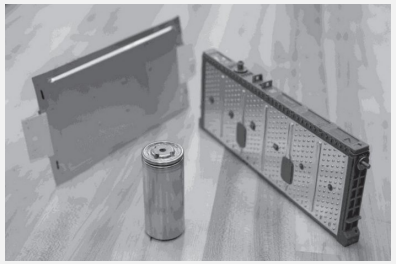
2015
2020
2025
2030

# *BESS Information: Cell→System*



## Cell

Cell-level integration

Cell testing and screening

## Module

Module-level integration

Module testing

## Unit

Unit-level integration

Unit testing

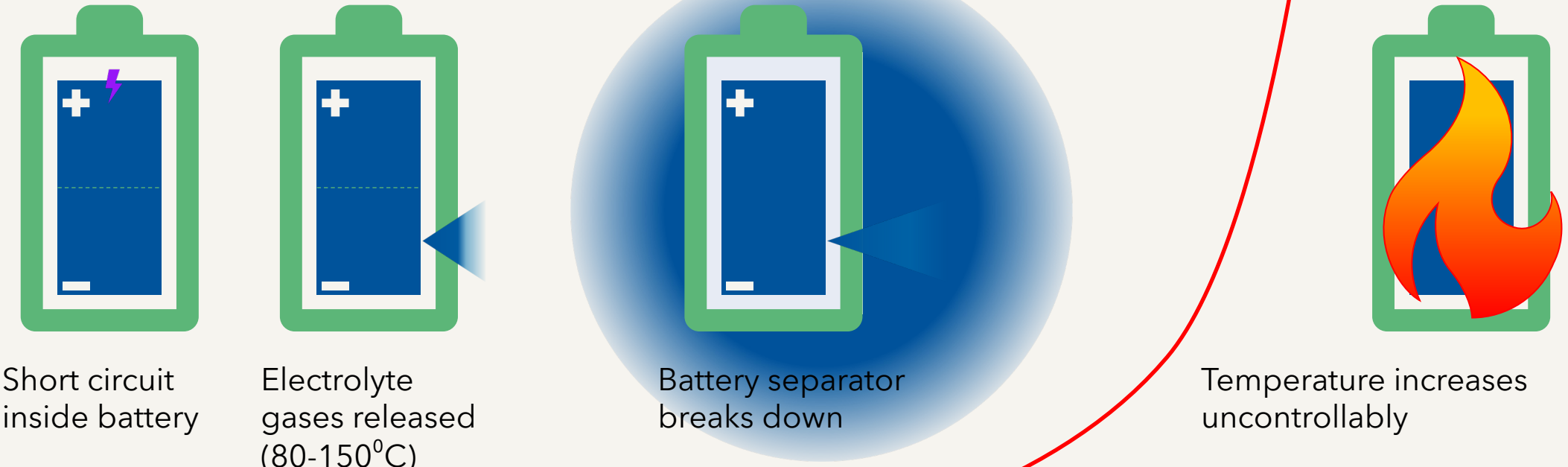
## Lithium Battery System

Includes BMS, detection, suppression

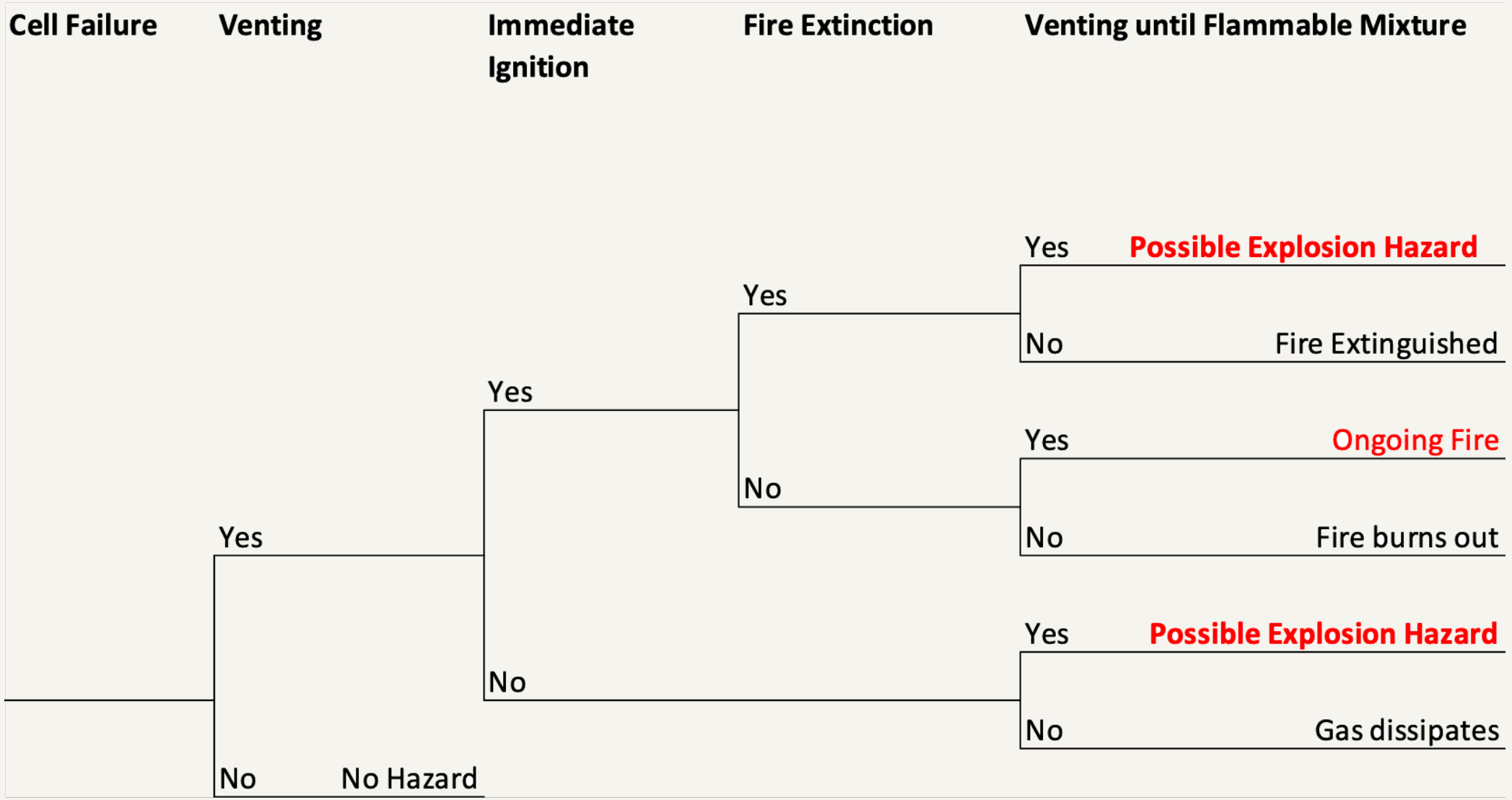
# *Hazards*

- Fire
- Explosion
- Stranded Energy

# *Thermal Runaway*



# *Anatomy of an Event*



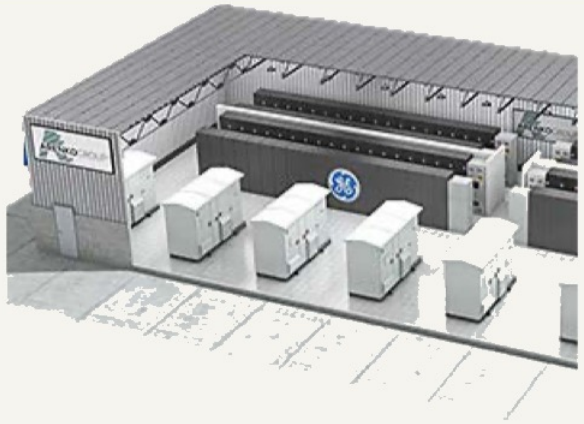

MOORABOOL
FIRE DESTROYS LITHIUM BATTERY
THE VICTORIAN BIG BATTERY PROVIDES 'CRUCIAL' ENERGY STORAGE
7 NEWS

# *Challenges*

- Inconsistent code adoption and varied interpretations/requirements
- Poorly written contracts & design
- Products not tested to latest standards (design cycles initiated prior to standard issuance)
- “One size fits all (most)” doesn’t necessarily work if price is critical
- Lack of understanding/risks of systems by manufacturers, integrators, developers, FD, and yes, even FPE’s
- Competing interests (supplier, owner/operator, AHJ, etc.)
- Appropriate design of safety systems

# *Types of Installations*

**Dedicated Use Building**

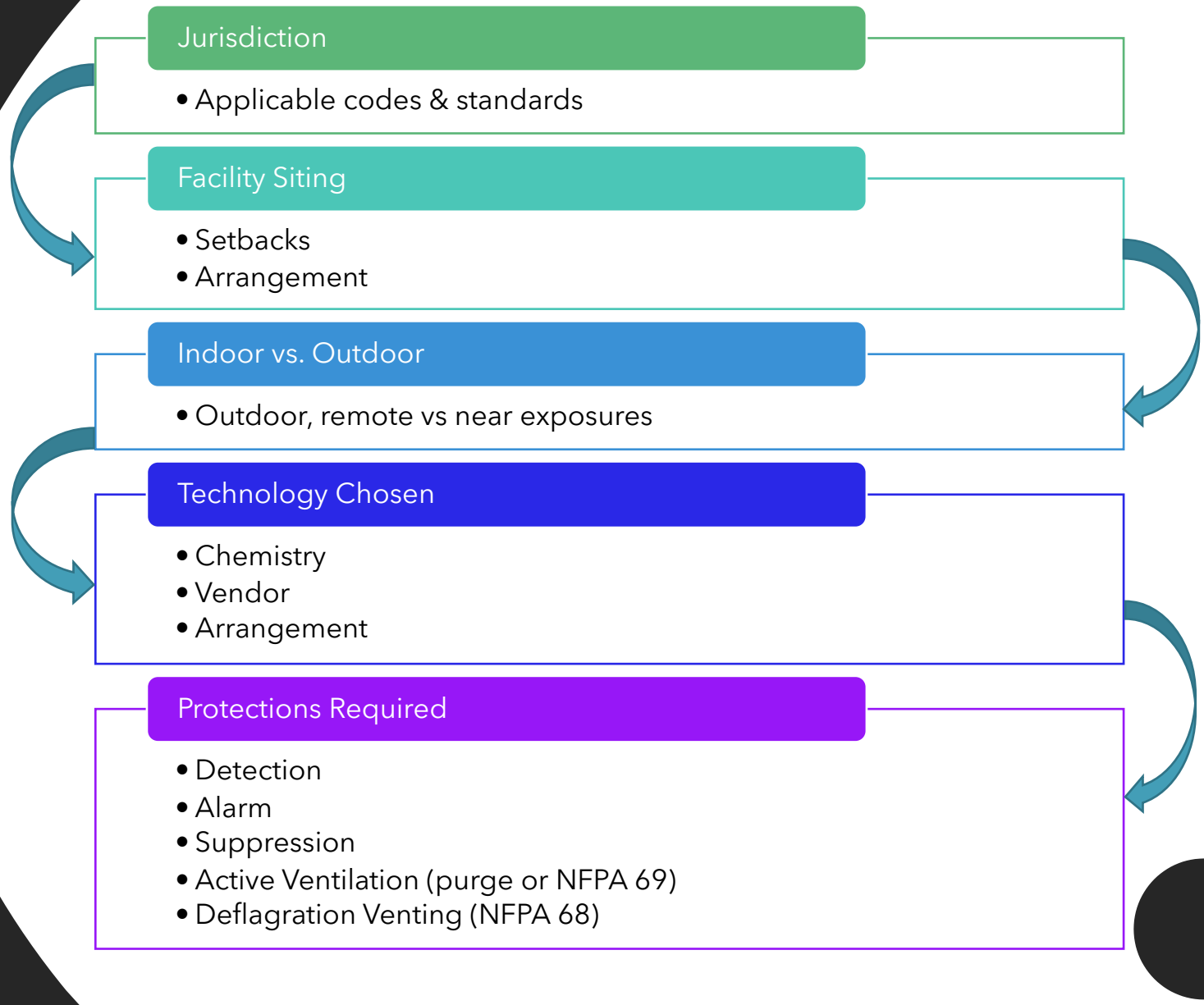


**Outdoors Near Exposures**

**Non-Dedicated Use Building**

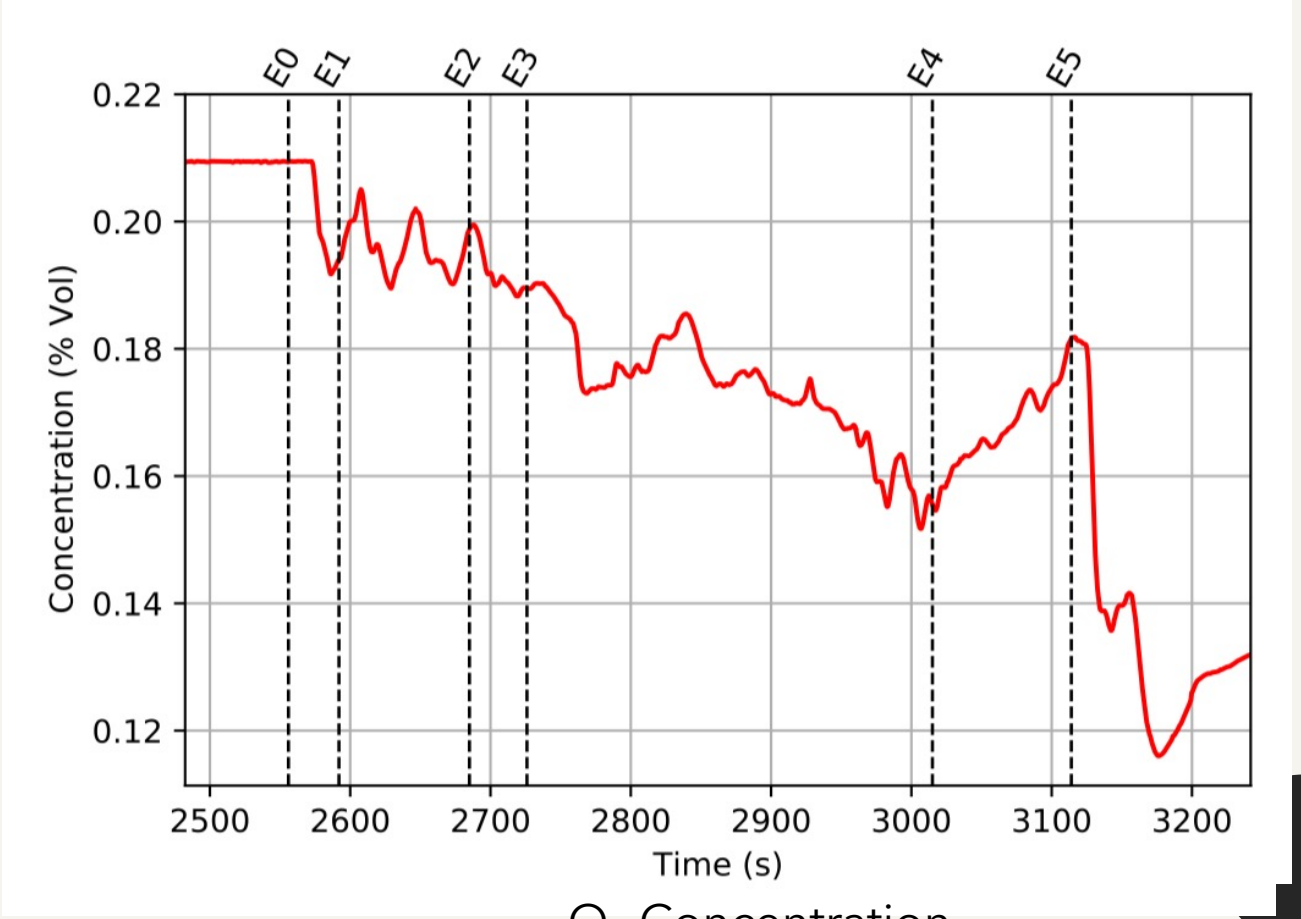
**Outdoors Remote**

# *BESS Roadmap & FPE Roles*



# *Unit ESS Testing with Suppression Agent*

| Test Time | Event (ID) |
|---|---|
| 0:00:00 (0s) | Test Start |
| 0:40:00 (2400s) | Cell Failure Event |
| 0:42:22 (2556s) | Thermal Runaway (E0) |
| 0:43:12 (2592s) | Smoke Alarm (E1) |
| 0:43:18 (2598s) | Release Event |
| 0:44:45 (2685s) | Smoke Alarm (E2) |
| 0:45:26 (2726s) | FSS Discharge (E3) |
| 0:50:15 (3015s) | Ventilation (E4)* |
| 0:51:54 (3114s) | Deflagration (E5) |
| 0:54:02 (3242s) | Test End |




$O_2$ Concentration