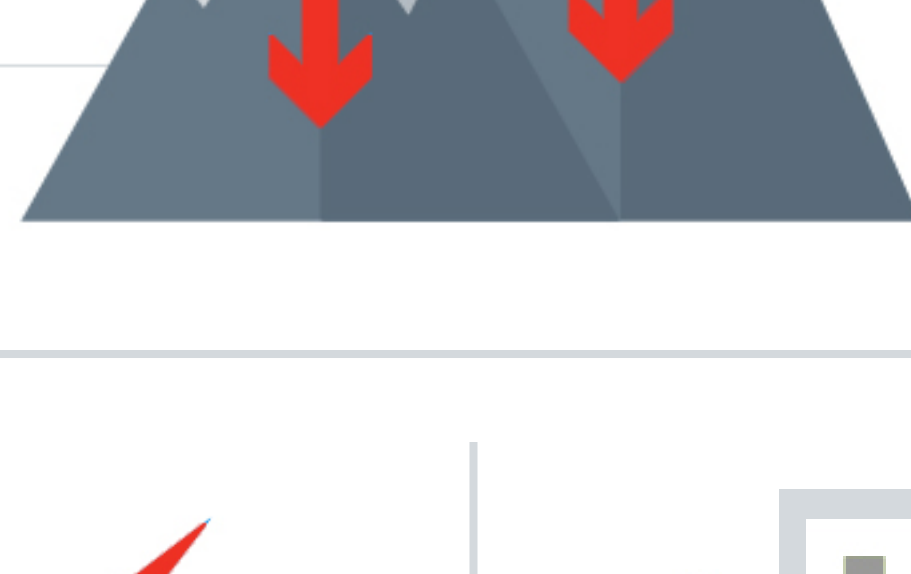


BURNING TRUTHS ABOUT LI-ION BATTERY FIRES

LI-ION BATTERY STORAGE: THE ANSWER TO GREEN, SMART GRIDS

**PEAK
OFF-
PEAK**

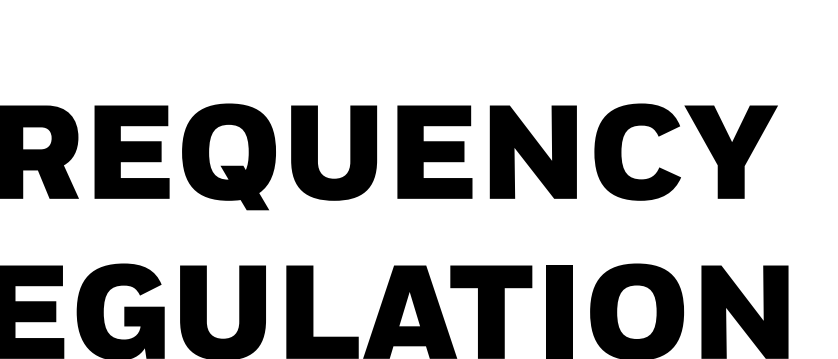


**PEAK
SHIFTING**



**RENEWABLE
POWER
INTEGRATION**

**+
-**



**FREQUENCY
REGULATION**

BUT THE THREAT IS REAL

23



LI-ION BATTERY ENERGY STORAGE SYSTEM (BESS) FIRES IN SOUTH KOREA (2017-2018)¹

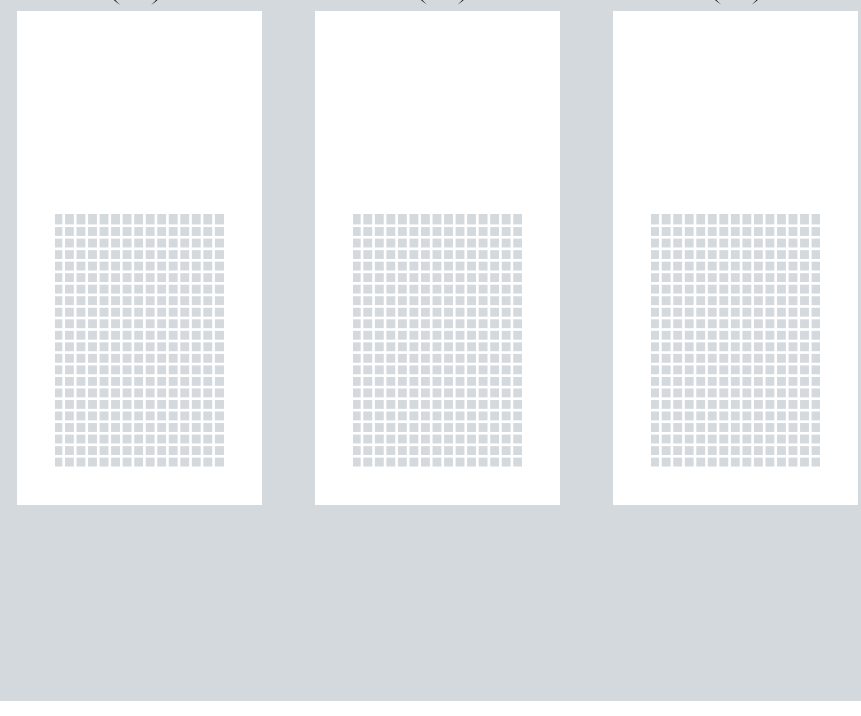
4



FIREFIGHTERS SEVERELY INJURED BY BESS EXPLOSION IN ARIZONA, US (2019)²

20MW

BESS DESTROYED BY FIRE IN LIVERPOOL, UK (2020)³



LI-ION BESS FIRES HAPPEN IN 4 STAGES

1

**ABUSE
FACTOR**

(ELECTRICAL/THERMAL/MECHANICAL)



2

**BATTERY
ELECTROLYTE
SOLVENT VAPORS**



3

SMOKE



4

FIRE

(THERMAL RUNAWAY)



KEY RISKS AND CHALLENGES INCLUDE



**FORMATION OF
EXPLOSIVE GAS/
VAPOUR MIXTURES**

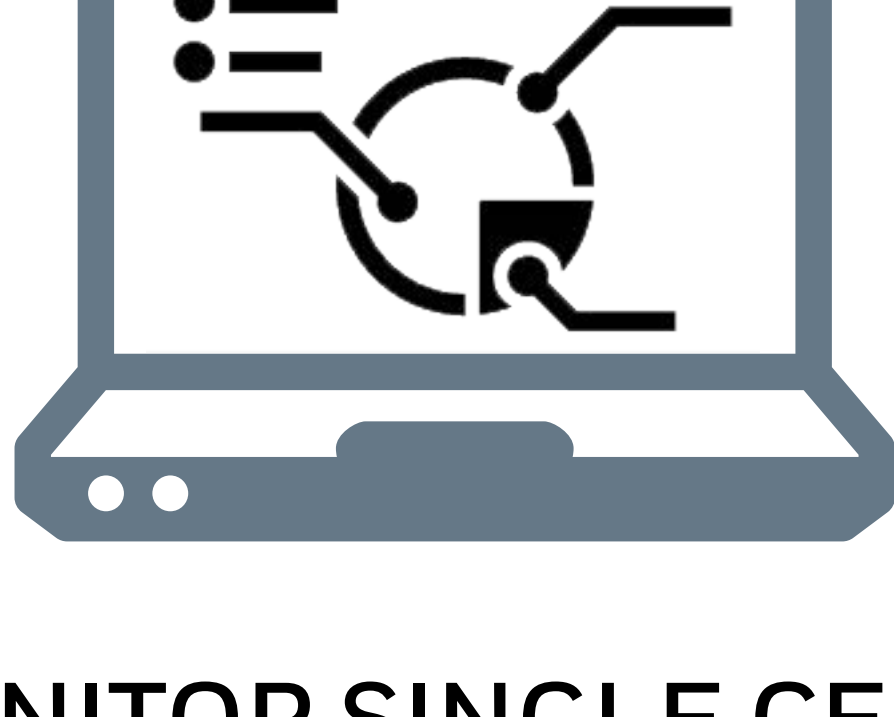


**FORMATION AND
DISPERSION OF
TOXIC GAS CLOUDS**



**INTENSE HEAT
FIRES (DIFFICULT
TO EXTINGUISH)**

EXISTING TECHNOLOGY CANNOT



MONITOR SINGLE CELL TEMPERATURES/VOLTAGES (BMS)



ACTIVATE UNTIL THERMAL RUNAWAY HAS OCCURRED (FIRE DETECTION/SUPPRESSION)

ELECTROLYTE VAPOR DETECTION, THE OPTIMUM LI-ION BESS FIRE PREVENTION TECHNOLOGY

ELECTROLYTE VAPOR SENSOR AVERAGE ACTIVATION TIMES⁴:

00:00

MINS

SECS

BEFORE
THERMAL
RUNAWAY

00:00

MINS

SECS

BEFORE CELL
VOLTAGE
SENSORS

00:00

MINS

SECS

BEFORE LEL
SENSORS

¹ <http://www.businesskorea.co.kr/news/articleView.htm?idxno=41012>

² https://firefightersafety.org/docs/Four_Firefighters_Injured_in_Lithium_Ion_Battery_ESS_Explosion_Arizona.pdf

³ <https://www.energy-storage.news/news/fire-at-20mw-uk-battery-storage-plant-in-liverpool--text-Carnegie%20Road%20BESS%20in%20Liverpool-when%20completed-%20in%20early%202019-&e=The%20fire%20service%20said%20that%20the%20fire%20in%20the%20incident>

⁴ <https://www.dnvg.com/maritime/publications/Technical-Reference-for-Li-Ion-Battery-Explosion-Risk-and-Fire-Suppression-report-download.html>