



Lithium-Ion Risk Prevention System

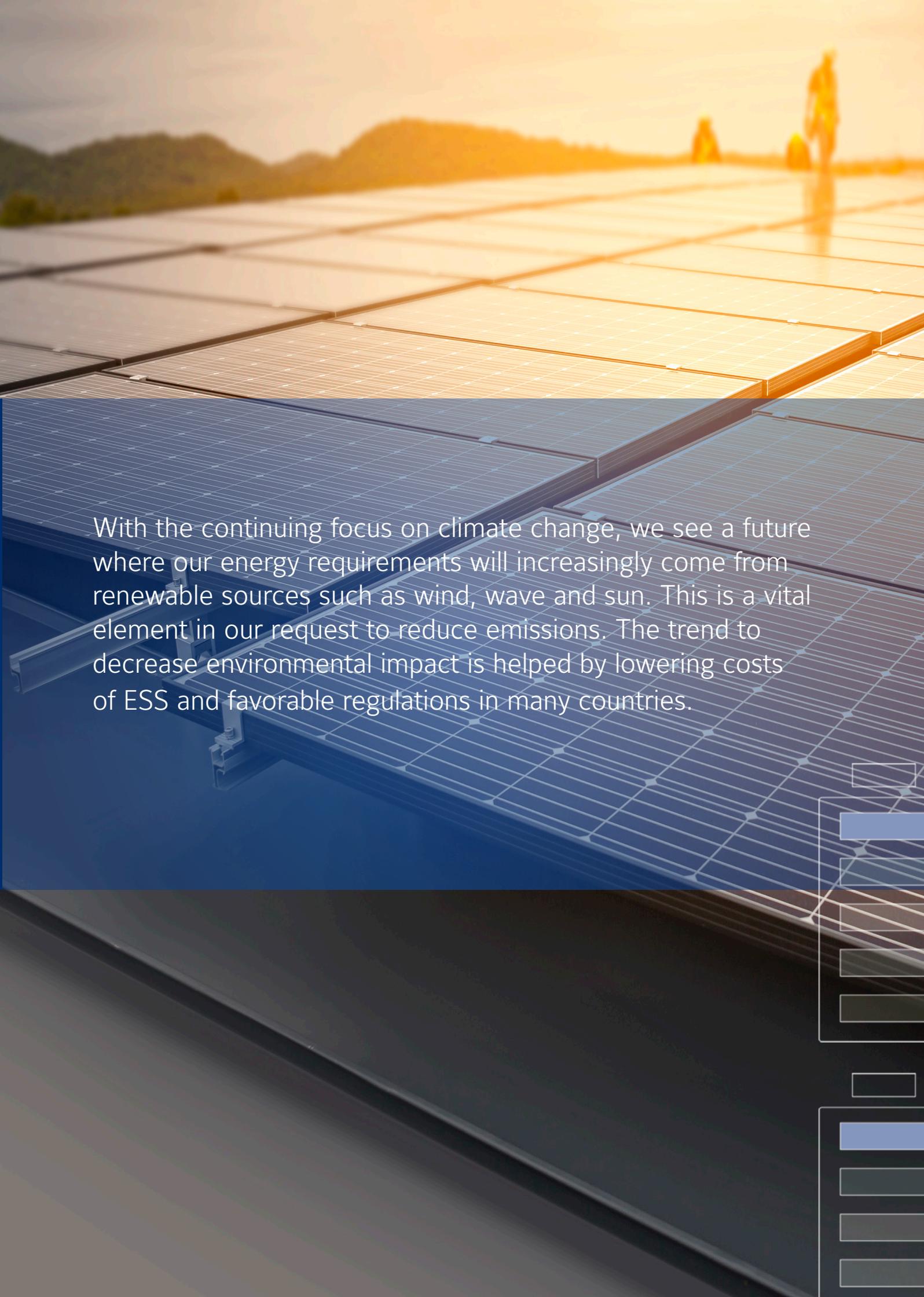


The power behind **your mission**



Introducing Lithium-Ion Risk Prevention System

Lithium-Ion battery technology is leading the way while continuously evolving for Energy Storage Systems (ESS). The systems will vary in materials of construction and configuration depending on use and application. Larger batteries are often found in ESS.

A wide-angle photograph of a solar farm at sunset. The rows of solar panels stretch into the distance, reflecting the golden light of the setting sun. In the background, several workers in safety gear are visible, silhouetted against the bright sky. The overall atmosphere is warm and hopeful, symbolizing clean energy and sustainable development.

With the continuing focus on climate change, we see a future where our energy requirements will increasingly come from renewable sources such as wind, wave and sun. This is a vital element in our request to reduce emissions. The trend to decrease environmental impact is helped by lowering costs of ESS and favorable regulations in many countries.



Introducing Lithium-Ion Risk Prevention System

The advancement in Lithium-Ion battery technology that can be used in place of, or additionally to more traditional UPS (Uninterrupted Power Supply) technologies, is further driving the growth in demand for Lithium-Ion battery technology.

The demand for power is expanding globally, but some markets are moving at a quicker pace where there are huge investments in Lithium-Ion battery technology. As regulations become more stringent and financing more readily available, the growth will spread to other regions.

However, Lithium-Ion batteries can pose severe risk if a cell begins to operate abnormally, resulting in an increase in temperature, which if not addressed could lead to a thermal runaway event.

Thermal runaway would normally start in a single cell before thermal propagation

creates a domino effect into adjacent cells, causing an increase in temperature in each of those cells. This can often lead to a destructive sequence of events which could continue for several hours or even days as each cell is consumed.

One of the early warning signs of a problem is the production of off-gases, and if detected early enough can allow actions to be taken that may prevent such a catastrophic event.

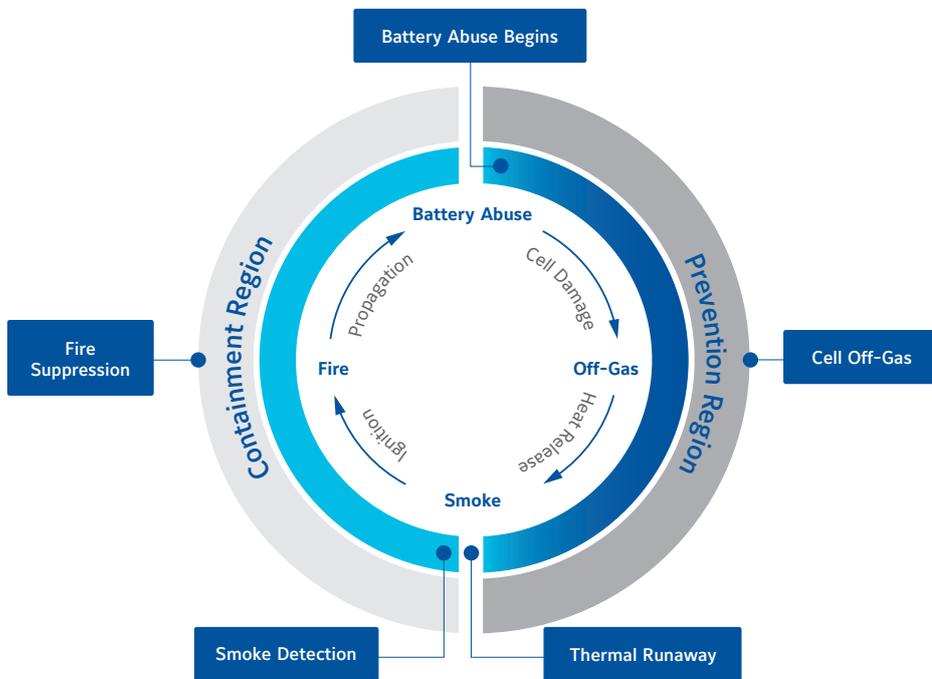
The Lithium-Ion Risk Prevention System is designed to monitor the batteries and detect these off-gases/toxic vapors in order to provide an early warning detection. There are two Lithium-Ion Risk Prevention Monitoring Sensors used in the system: a reference sensor and a monitoring sensor. The reference sensor provides surrounding ambient air data to the controller, while the monitoring sensor is placed within the battery racks or racking system to allow

for capturing data relating to the air directly adjacent to the Lithium-Ion batteries. The controller is constantly monitoring both the ambient environment and battery rack air for changes of less than 1 ppm of Lithium-Ion off-gas compounds.

The system is seeking to detect the presence of off-gases, indicating the early stages of battery cell malfunction prior to thermal runaway. The system will communicate with the battery management system, to shut down the failing batteries and, when combined with the AutoPulse, ZETTLER or FIRECLASS detection and Inergen® or SAPPHIRE® Fire Suppression Systems, may activate the suppression system to mitigate off-gas ignition, while providing local and remote alarms to inform personnel and emergency response teams.



Lithium-Ion Battery Failure Stages



Lithium-Ion Risk Prevention System

offers advanced early failure monitoring of Lithium-Ion batteries by detecting off-gases.

1

Stage 1: Battery Abuse

Thermal, Electrical or Mechanical abuse

2

Stage 2: Off-Gas Generation

Time to take ACTION

3

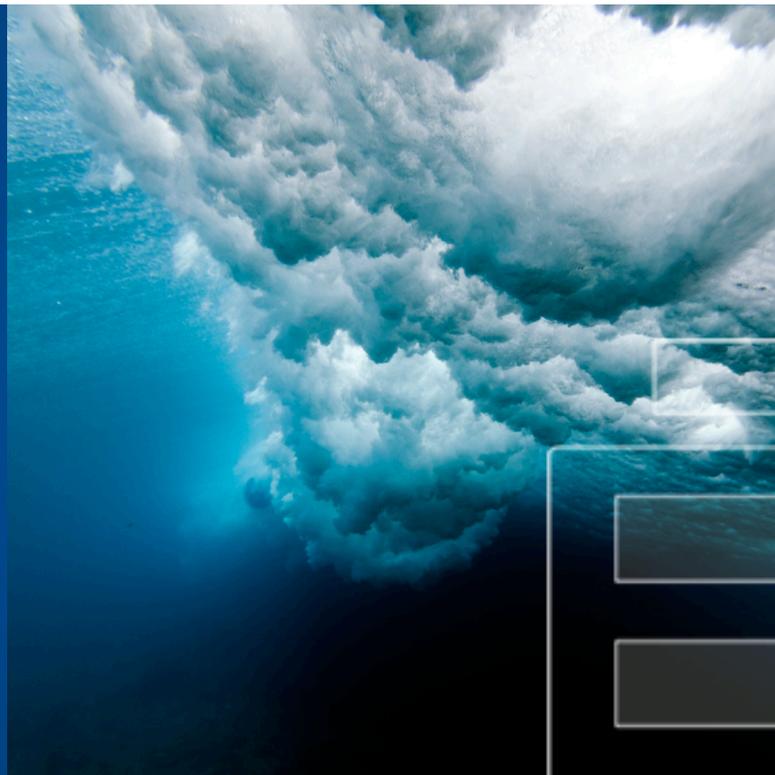
Stage 3: Smoke Generation

Catastrophic failure is imminent

4

Stage 4: Fire Generation

Propagation occurrence



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Features and Benefits

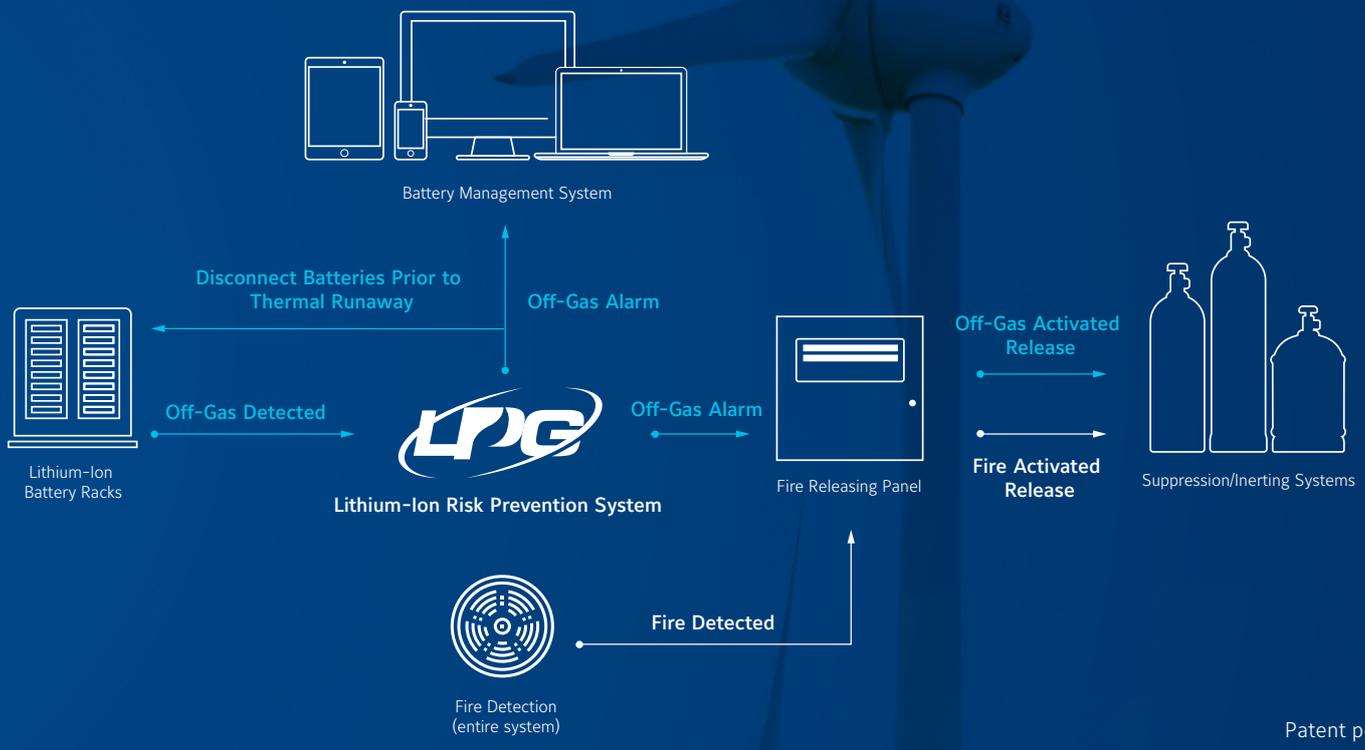
- Lithium-Ion battery technology for Energy Storage Systems
- Provides an early warning detection of off-gases/toxic vapors
- 5 second response time
- For use with AutoPulse, ZETTLER or FIRECLASS Detection and Inergen® or SAPPHIRE Fire Suppression Systems
- Patent pending



Applications

- Wind Farms
- Solar Farms
- Data Center/Battery Rooms
- Battery Manufacturers
- Engineering, Procurement and Construction (EPCs) companies

Lithium-Ion Safety System Operation



Patent pending

About Johnson Controls

At Johnson Controls, we transform the environments where people live, work, learn and play. From optimizing building performance to improving safety and enhancing comfort, we drive the outcomes that matter most. We deliver our promise in industries such as healthcare, education, data centers and manufacturing. With a global team of 105,000 experts in more than 150 countries and over 130 years of innovation, we are the power behind our customers' mission. Our leading portfolio of building technology and solutions includes some of the most trusted names in the industry, such as Tyco®, York®, Metasys®, Ruskin®, Titus®, Frick®, Penn®, Sabroe®, Simplex®, ANSUL® and Grinnell®.

For more information, contact your regional Fire Suppression product representative, or visit www.lpgfiresuppression.com

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