ASCO Power Technologies™

Isolation Requirements for Inverter-Based Standby Power Applications

ascopower.com/sourcepact

Life Is On | Schneider Electric

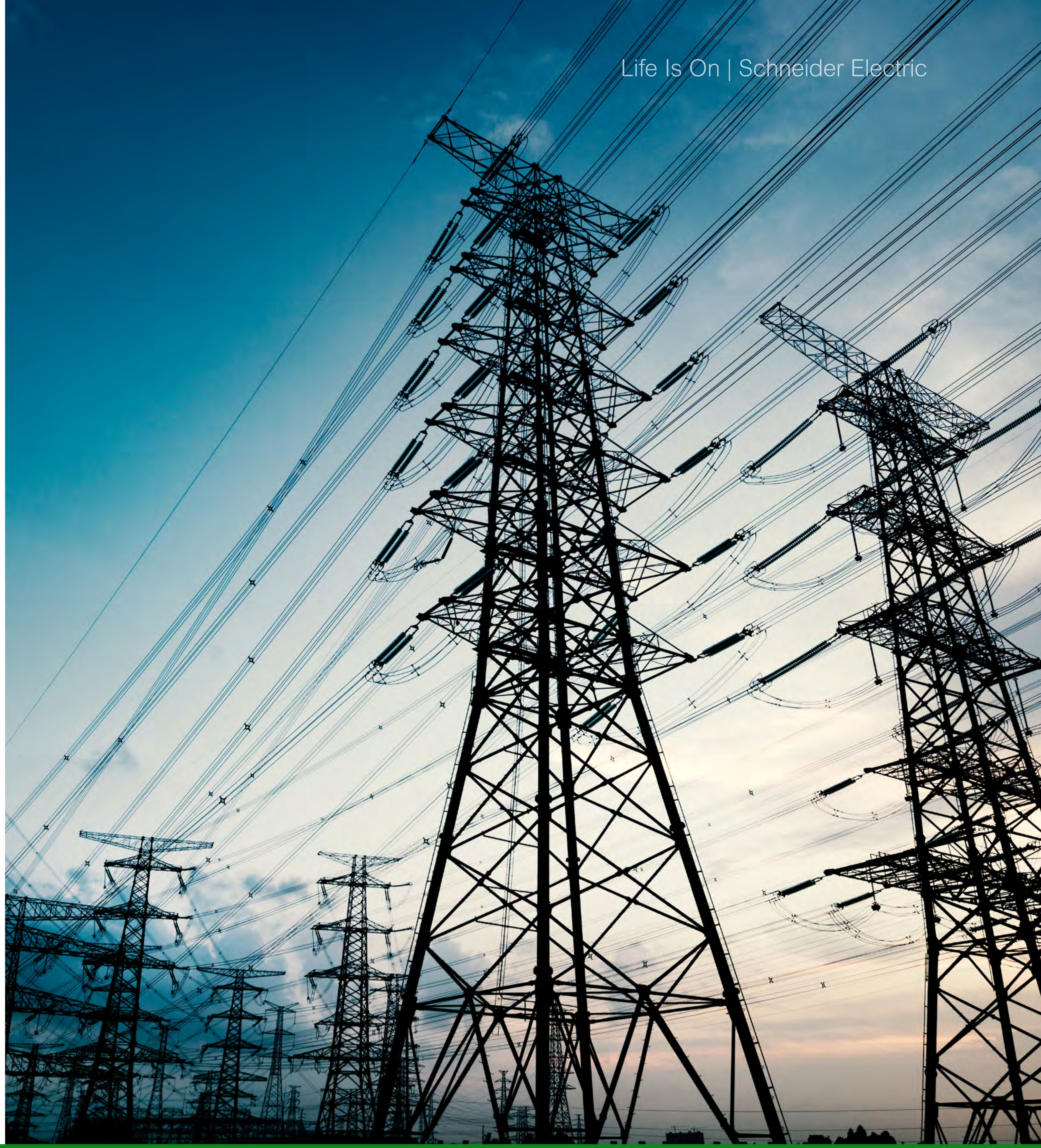
Table of contents

Introduction

Introduction

As utility power grids age and extreme weather events have become more frequent, the occurrence and impact of power outages have increased. According to the US Energy Information Agency (EIA), between 2013 and 2021, outage frequency increased from 1.2 to 1.42 events per customer per year. EIA also states that the average duration of a power outage in the U.S. grew from approximately 3.5 hours to more than seven hours. For businesses, such power losses lead to production downtime, high restart costs, and reduced operational efficiency.

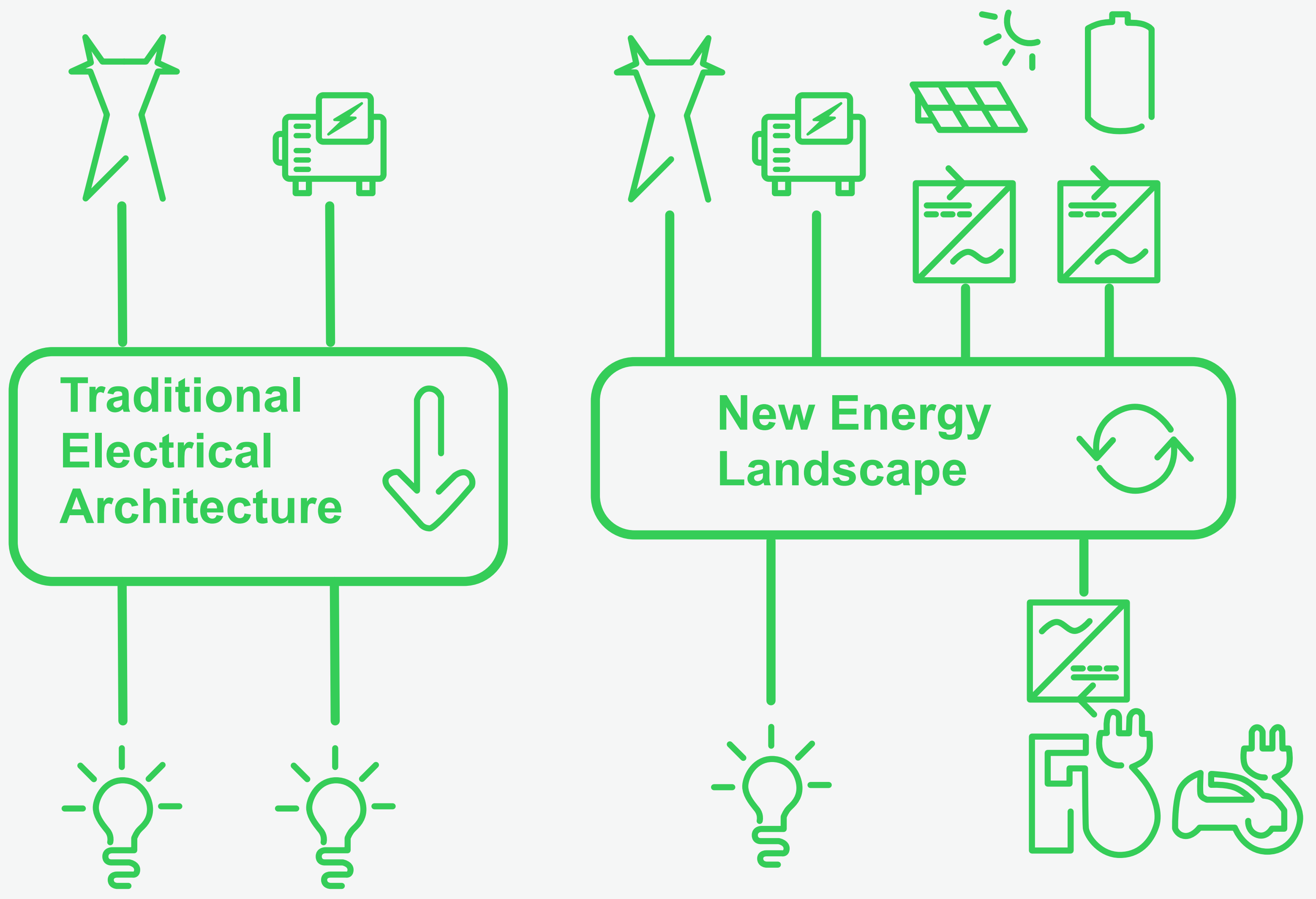
These trends together with carbon emissions reduction goals drive demand for new energy solutions at all levels. The market drivers for these changes include a need to optimize energy costs; increasing power resilience; and emissions-reduction targets across many industries. In such a rapidly evolving energy marketplace, some governments such as the State of California have passed laws mandating solar panels and energy storage systems, and funding has become available at the federal, state, and local levels to accelerate the adoption of renewables. This New Energy Landscape includes solar arrays, battery energy storage systems (BESS), inverters, microgrids, and more. The learning curve for deploying these systems can be steep for engineers and facility stakeholders.



Introduction (cont.)

Consider the deployment of BESS and other inverter-controlled sources. Producing and storing power sounds easy but using these assets to provide standby and emergency power is not as simple as it seems. When dealing with onsite power, errors can threaten human safety and damage equipment. However, there are misconceptions about using solar and stored energy directly for backup purposes.

Using these new energy resources to supply emergency power requires the isolation of inverter-controlled sources and their essential loads from utility feeds. This **isolation** enables inverters (devices that convert DC to alternating current) to switch between grid-following and grid-forming operating modes when utility power is interrupted and restored. The *2023 National Electrical Code* permits BESS and other inverter-controlled systems to back up a facility's essential loads.



- **Utility is primary source**
- **Energy flows from grid to user**
- **Generator supplies emergency power**

- **Energy derived from multiple sources**
- **Energy flows from and to utility**
- **Distributed Energy Resources supply emergency power**

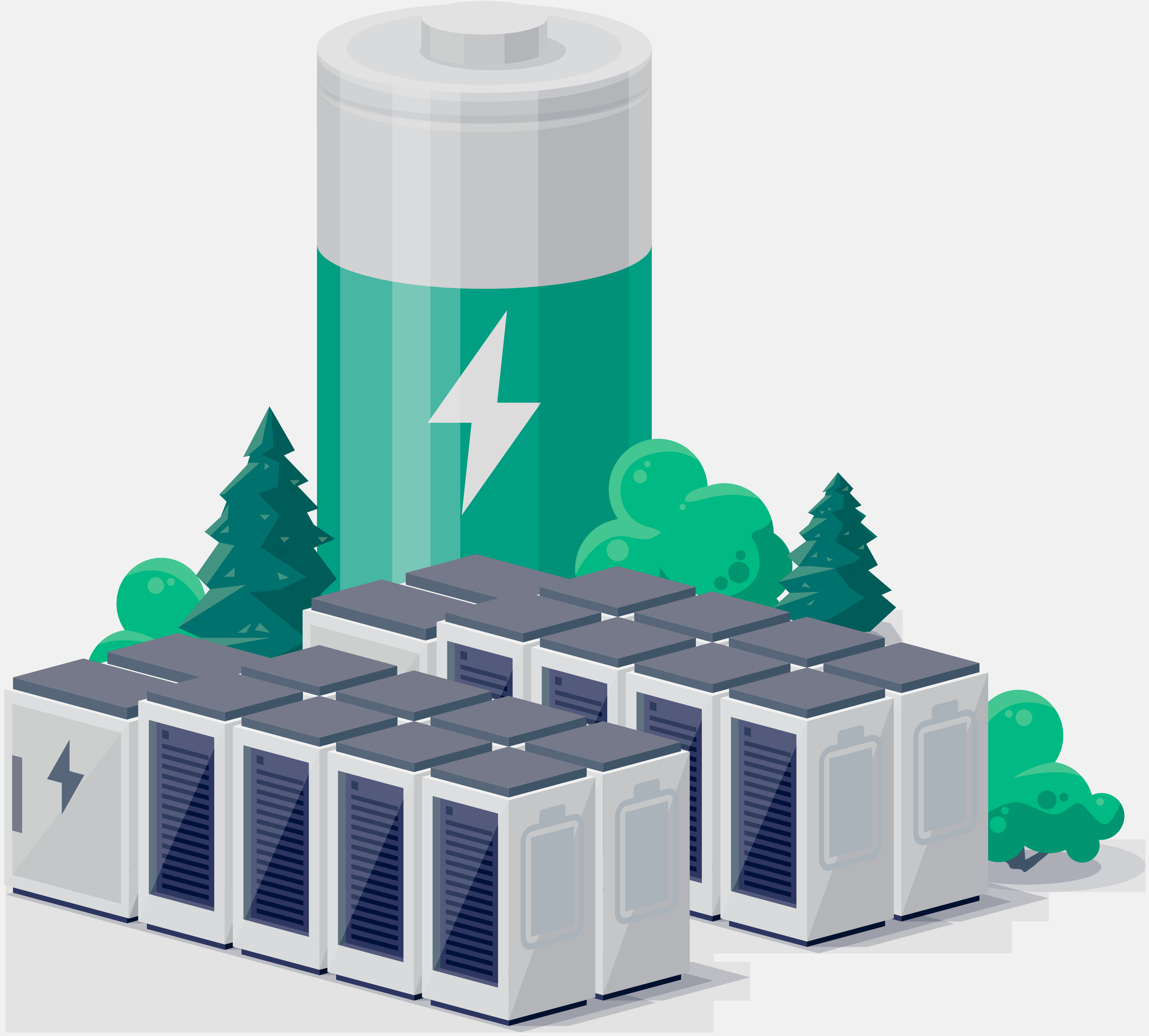
Inverter and BESS basics

Introduction
Inverter and BESS basics
Load Transfer vs. Source Isolation
The New Provisional UL 3008 Guidance
Source**PacT**, the first UL 3008 isolation switch
Applications
Summary

Inverter and BESS basics

In conventional applications, utility-generated alternating current (AC) is transported through transmission lines to become a facility's primary power source. In this conventional configuration, energy flows in one direction from central generation to the facility. For resilience, an on-site, standby, fossil-fueled generator set is used. An Automatic Transfer Switch detects when a grid outage occurs, then signals a genset to start and accept electrical load. Even with generator, power flows one direction. At no point are utility and gen paralleled.

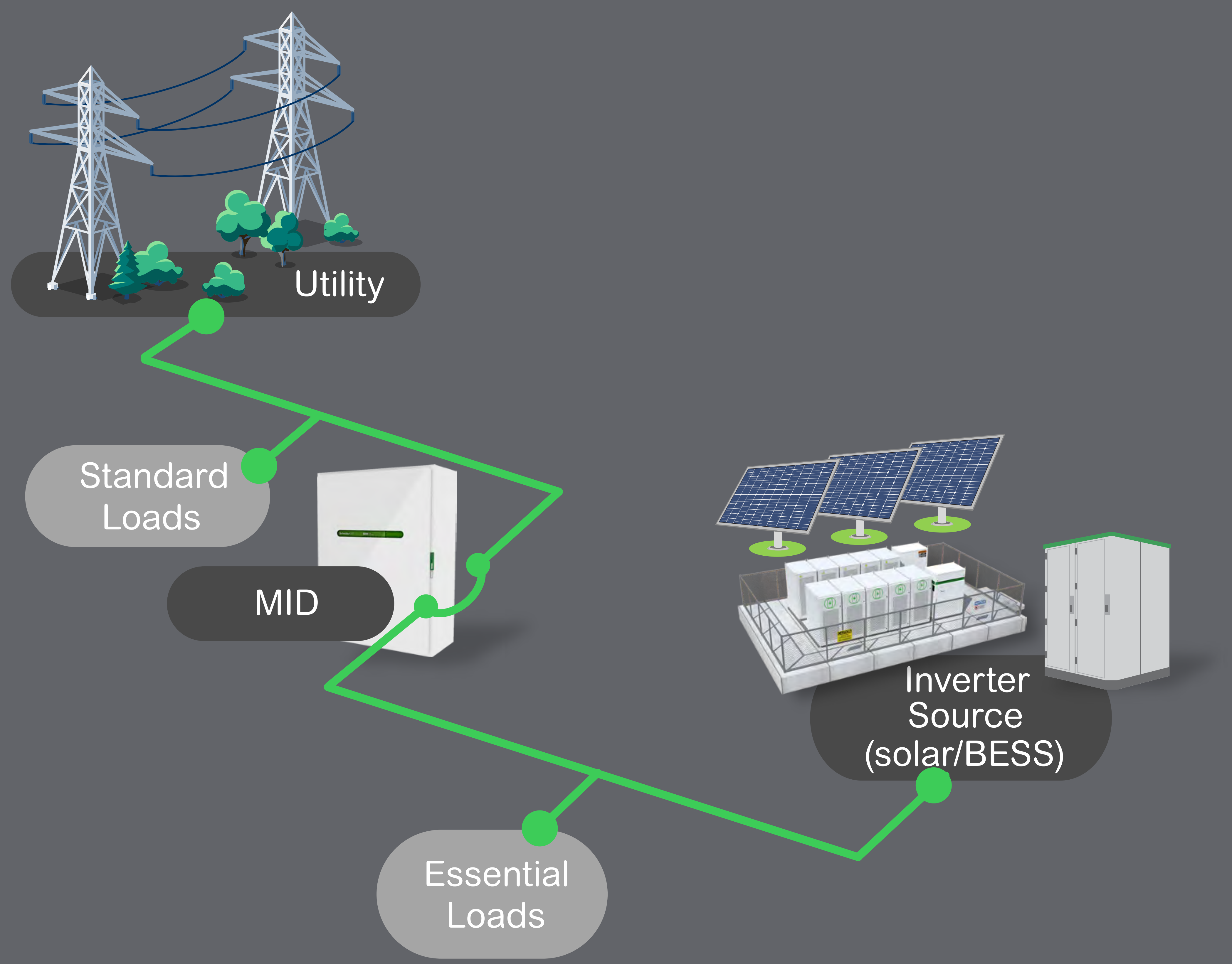
The New Energy Landscape introduces technologies like inverters, distributed energy resources, and BESS, which enable energy to flow bidirectionally between a facility and a utility grid, or within the facility's own distribution system, as electricity supply and demand change. A facility can use stored energy when utility rates are high, as resilient backup power during utility outages, or sell it back to a utility when it makes sense to do so. In this model, BESS can act as a load when surplus power is available.



Inverter and BESS basics (cont.)

Most renewable sources provide direct current (DC) power. Inverters convert DC to the AC power used by most loads. An inverter can be paired with DC power resources like solar, hydrogen fuel cells, or batteries. Inverters form a modern BESS system when paired with batteries and a charge controller. This system charges batteries and then discharges as supply and demand conditions change. Many inverters can operate in two distinct modes:

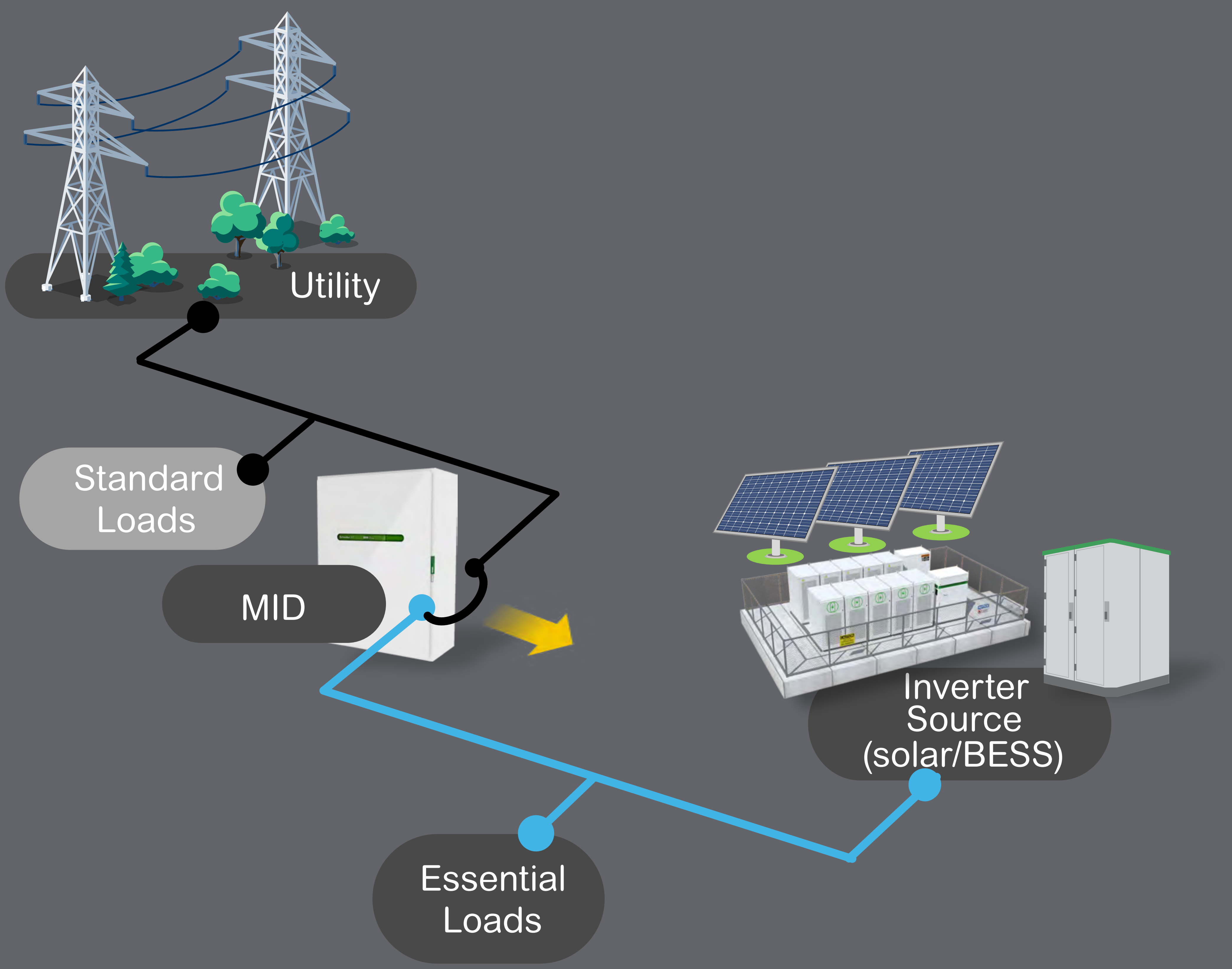
1. **Grid-Following Mode** (Grid-Tie Mode, Grid-Interactive Mode) – The inverter synchronizes its power delivery to utility power through the same bus. These sources operate in parallel, and the inverter shuts down if the synchronized source becomes unavailable or unacceptable. This shut-down prevents an inverter-controlled source from back-feeding the utility, which could endanger people working on distribution equipment, overload the inverter, and damage batteries.



Inverter and BESS basics (cont.)

2. **Grid-Forming Mode** (Islanding Mode) – In this mode, an inverter and BESS produce power independent of another source. The only power source on the bus is the inverter itself.

There is confusion in the marketplace today regarding how inverters operate. Many stakeholders think that because they have solar panels or a BESS, they can run their facility on that source if an outage occurs. But this perception is inaccurate. Inverters that can run parallel with the utility MUST shut down when a utility outage occurs to avoid utility back-feed. To power essential loads directly, an inverter must shutdown and await a signal from an energy management or control system indicating its essential loads are isolated. Once isolated, an inverter can safely resume operation and power these local essential loads. This also reduces overall load on the inverter.



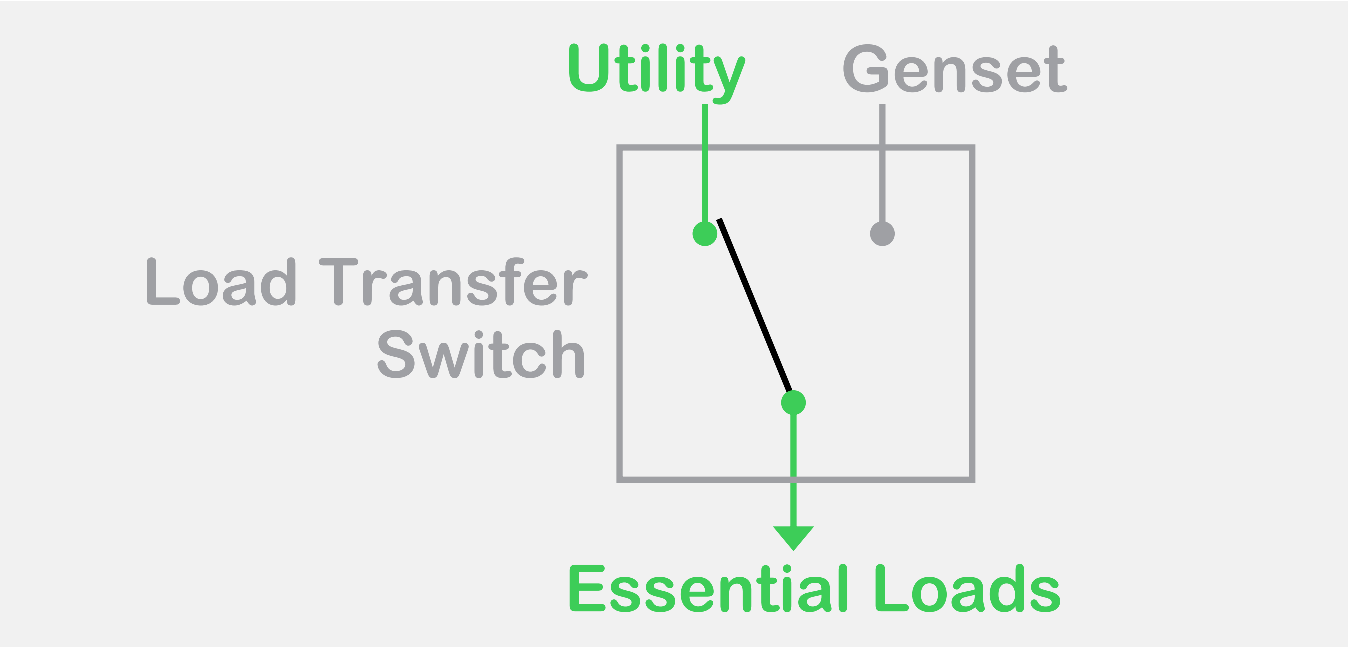
Load Transfer vs. Source Isolation

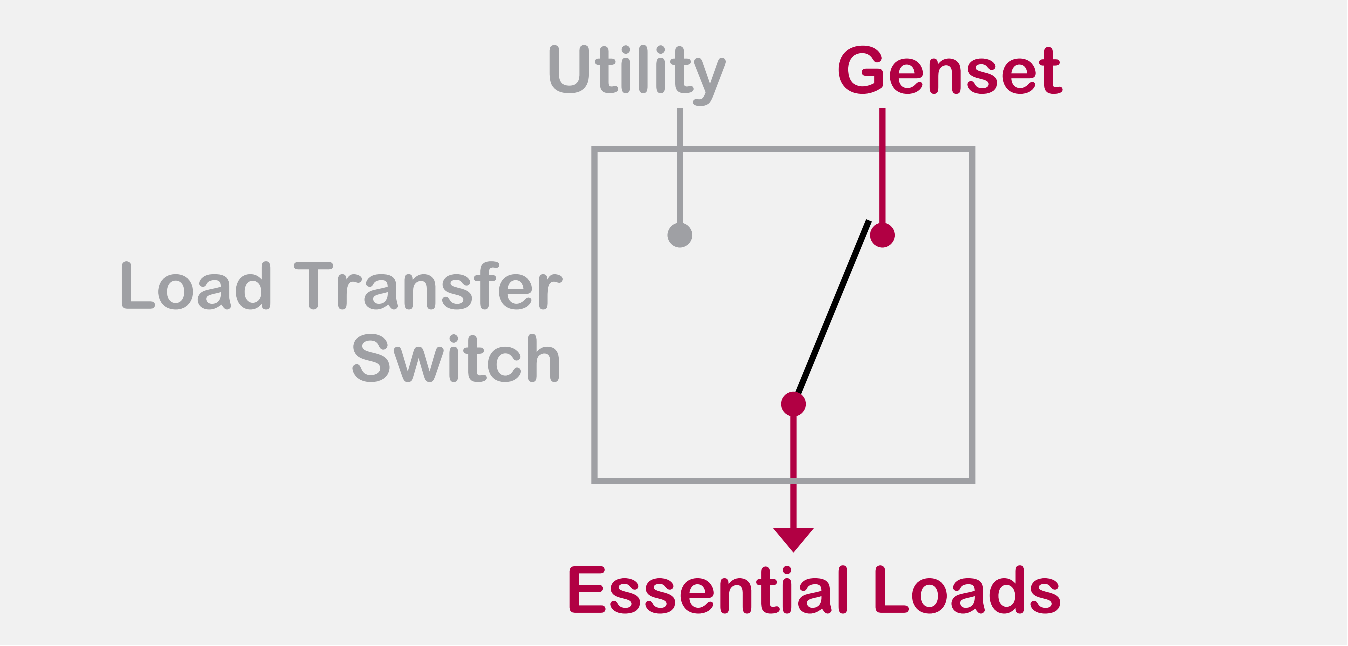
Load Transfer vs. Source Isolation

Additional confusion surrounds the differences between power source transfer and isolation. When a utility outage occurs, conventional power backup systems use transfer switches to transfer electrical load to a standby generator. However, transfer switches are not fundamentally designed to isolate their load, but to keep load connected to one of two sources, at least one of which is energized.

Using a transfer switch to achieve isolation involves labor-intensive, complex, and expensive workarounds, including adjustments to sequences of operations. Because of a lack of standardization, this approach can make compliance with national and local codes difficult and commissioning more complex. In addition, a custom solution will not carry the proper UL listings resulting from tested and proven isolation techniques.

TRANSFER:
Load always connected to one of two sources



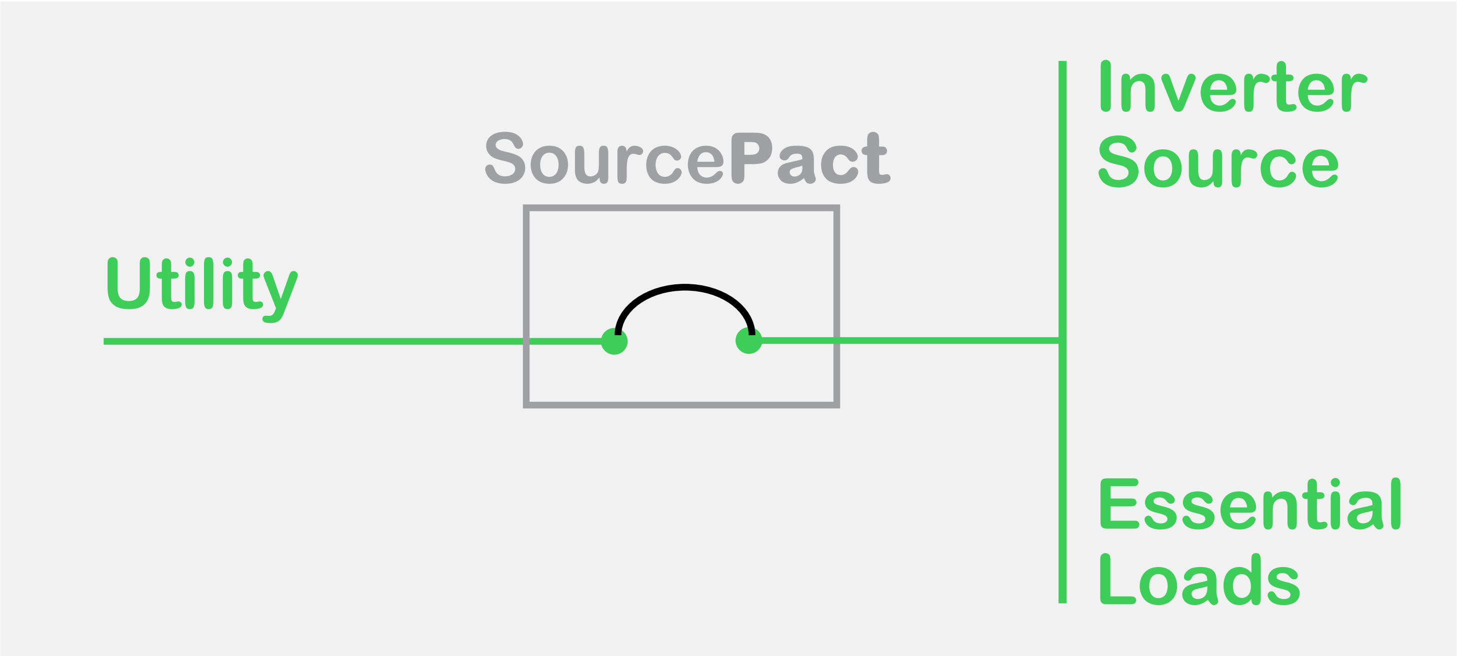


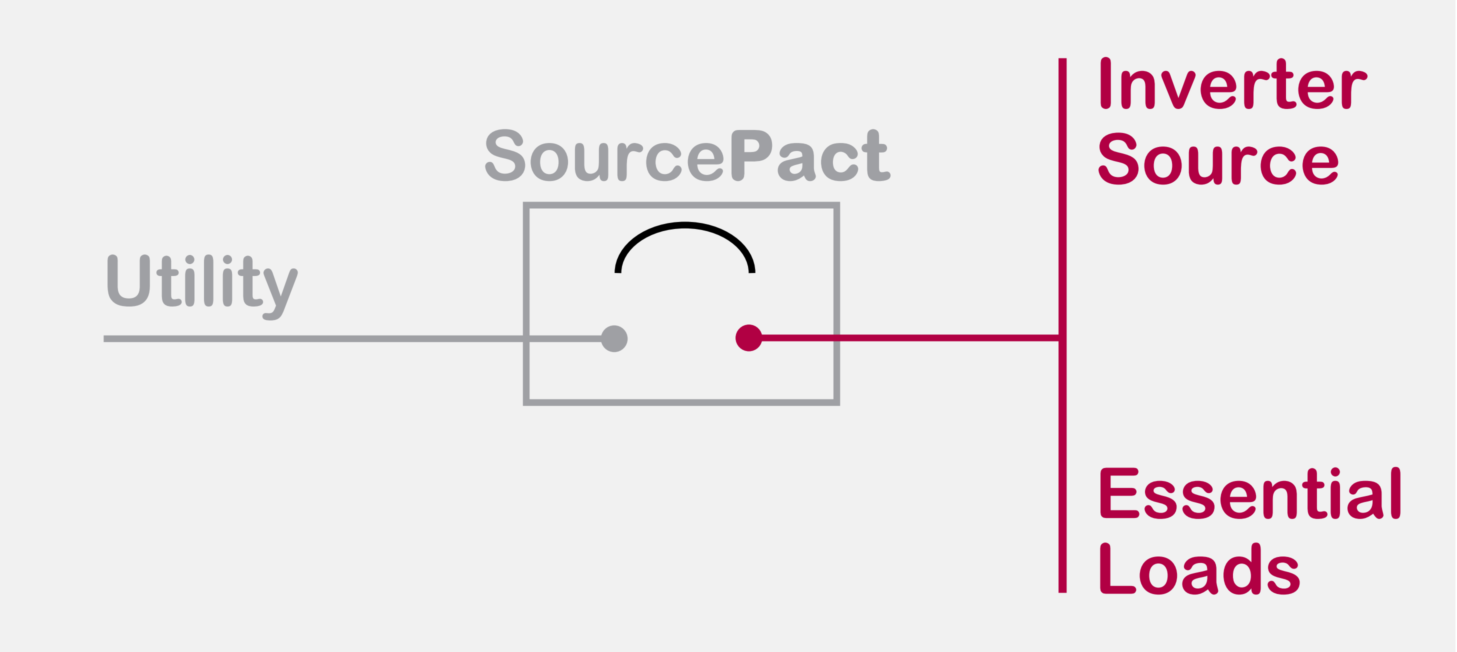
Load Transfer vs. Source Isolation (cont.)

In comparison, a source isolation switch (SIS) isolates a utility power source from a portion of the facility's electrical system and sends a mode-change signal to an inverter that it can supply power.

The signal prompts the inverter to transition from grid-following mode to grid-forming mode, producing power independent of the primary power source, typically a utility. When utility power returns, the SIS signals the inverter to resume grid-following mode and reconnects to utility power.

ISOLATION:
Load always connected to inverter – a dedicated switch automatically disconnects utility



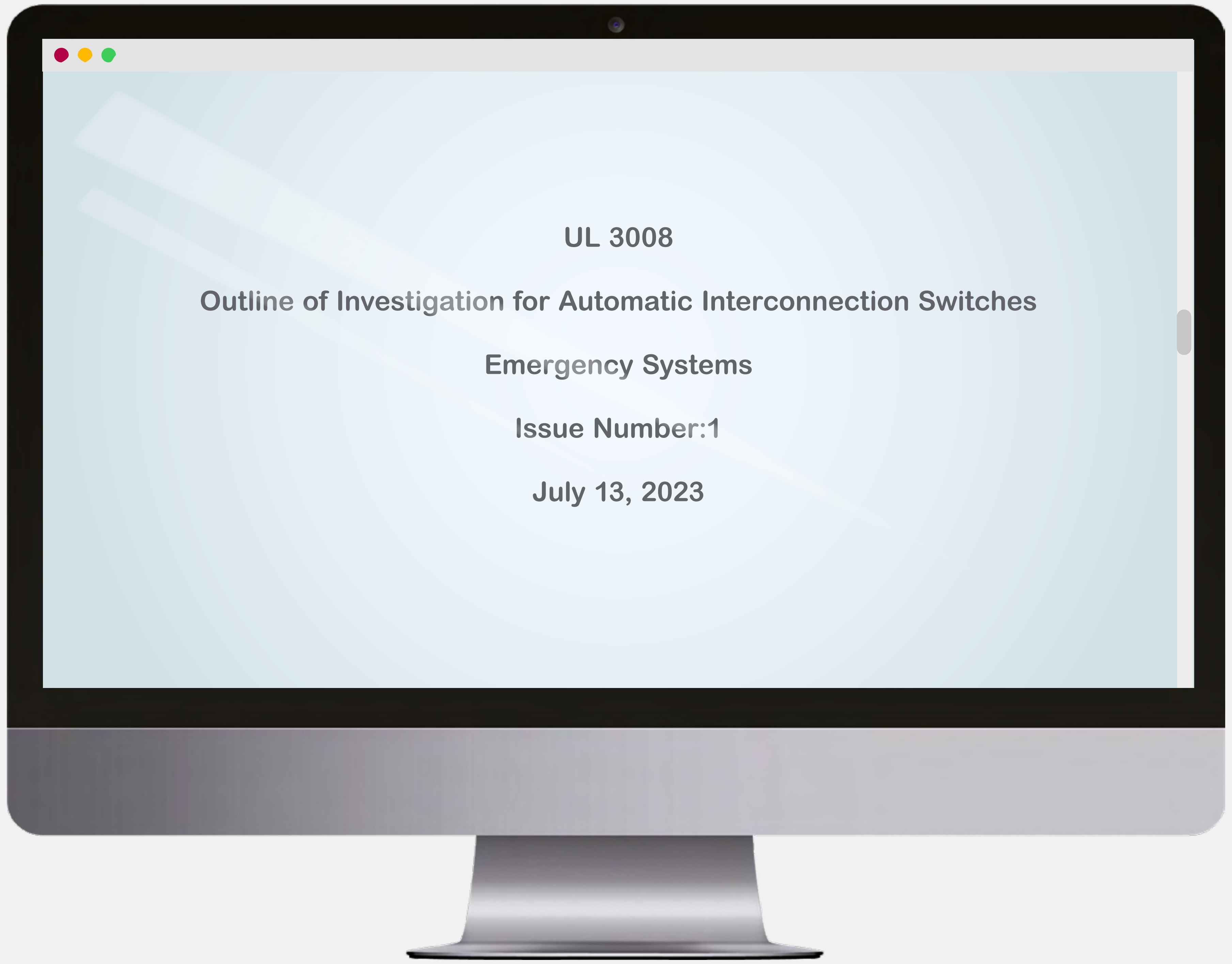


The New Provisional UL 3008 Guidance

The New Provisional UL 3008 Guidance

Underwriters Laboratories (UL) has released new guidance addressing power source isolation. *UL 3008 – Outline Of Investigation for Automatic Interconnection Switches for Emergency Systems* establishes guidelines for assessing the safe performance of devices that interconnect inverter-controlled, onsite power sources with utility grids. The new standard is based on *UL 1008 – Transfer Switch Equipment*, which, for decades, has defined how transfer switches should safely interact with generators in critical and emergency standby power applications. Like transfer switches, products that conform to UL 3008 are evaluated for parameters that include overload, endurance, temperature rise, and electromagnetic compliance to develop Withstand and Close-On Ratings.

UL 3008 is now available for review by interested stakeholders. UL will solicit additional comments and offer subsequent revisions before UL 3008 is finalized. Functionally, UL 3008 is the *de facto standard* for interconnect isolation switches today.



SourcePacT, the first UL 3008 isolation switch

Introducing SourcePacT, the first source isolation switch designed to UL 3008

The ASCO SourcePacT is a 3-phase source isolation switch that can be wall-mounted indoors or outdoors. This solution that avoids the typical "parts and pieces" approach to isolating a utility feed from an inverter and its essential loads. This ensures a quicker and less costly installation while boosting system reliability.

SourcePacT enables inverter-controlled sources to provide standby power.

Introducing SourcePacT, the first source isolation switch designed to UL 3008 (cont.)

As the first commercially available source isolation switch designed to UL 3008, SourcePacT helps stakeholders improve safety while simplifying design, installation, and operation. The table below summarizes key features and benefits:

Feature	Benefit
First product designed to UL 3008	The first standardized, off-the-shelf solution for safely enabling BESS to power essential loads and streamline NEC compliance
Sensing and control technology	When a utility outage occurs, SourcePacT automatically signals an inverter to operate in grid-forming mode
Purpose-built solution	Less expensive and less risky than custom-engineered solutions
Connects to inverters that accept Form C contacts	Brand agnostic signaling enables connection to inverters by various manufacturers
Single-box solution	Simple to integrate, distribute, and install
Automatic isolation and reconnection during outages	Avoids back-feed to a utility
Programmable settings for reconnecting a utility source	Flexible for operation across multiple power scenarios and architectures

Applications

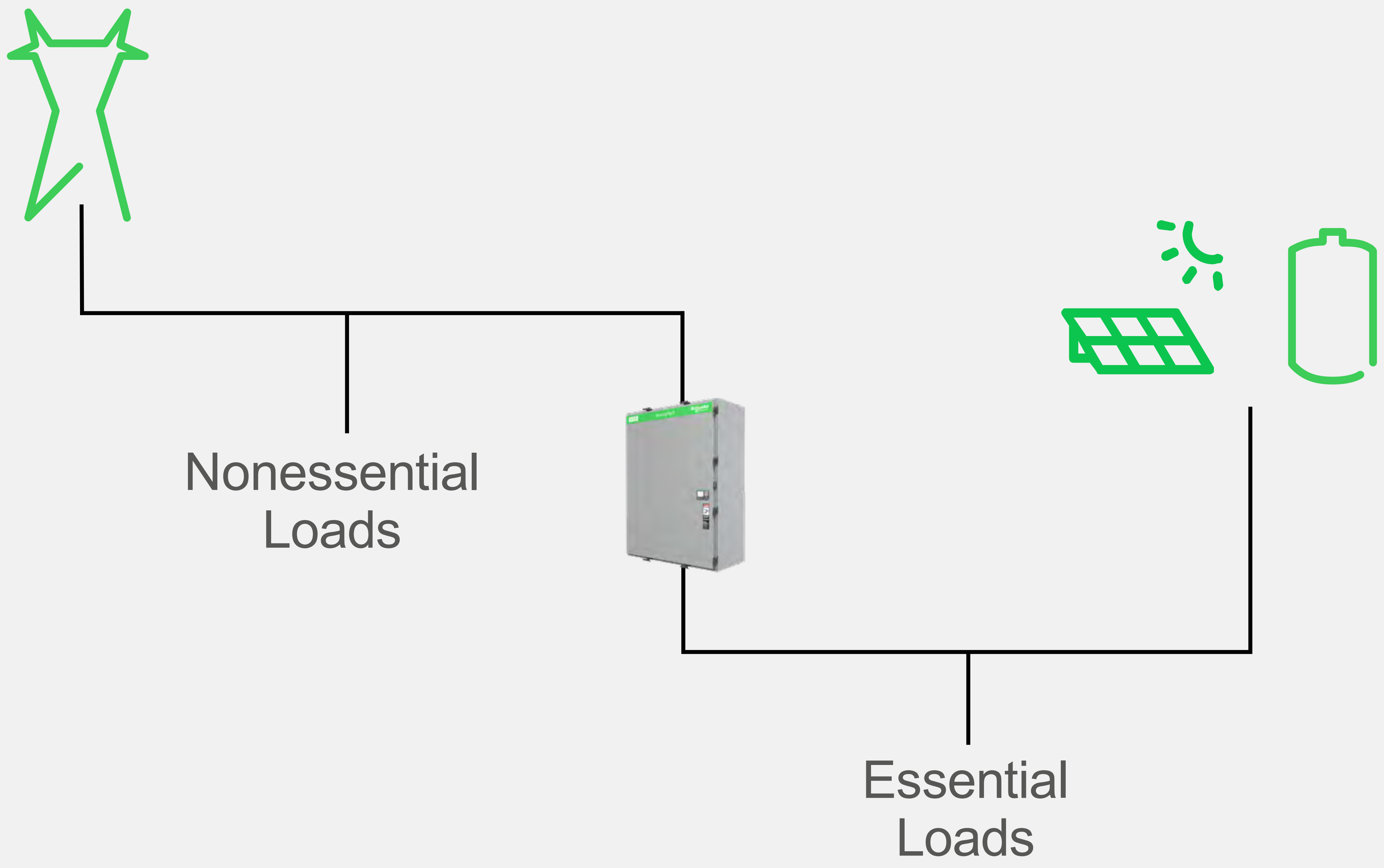
Applications

When a utility grid is normally delivering power to a facility, a BESS system and its inverter work in grid-following mode. Any excess power from onsite sources is stored in the batteries up to their maximum capacity. It also enables batteries to be charged when utility power energy is least costly and discharged when utility power rates are high. A Source**PacT** switch comes into play during a power outage by isolating an inverter and its essential loads from a utility grid so that inverters and their batteries can safely supply backup power in grid-forming mode. The following are just a few of the configurations that Source**PacT** could help stakeholders reach their economic goals and standardize BESS design for quick deployment.

Applications (cont.)

Battery-Only – In this configuration, a BESS is the only source of backup power. A SourcePacT switch is installed between a utility feed and an inverter. When an outage occurs, SourcePacT isolates the inverter from the utility feed and the BESS supplies backup power to select essential loads. After SourcePacT detects that utility power has been restored, it automatically signals the inverter to shutdown so that it can return to grid-following mode and closes the disconnect.

The advantage of a Battery-Only configuration is that, for a small incremental cost over the expense of a BESS, a facility gains power resilience without the capital and operating costs of a fossil-fueled generator set with its corresponding emissions. Backup power run-time is a function of the reserve energy available in the BESS.

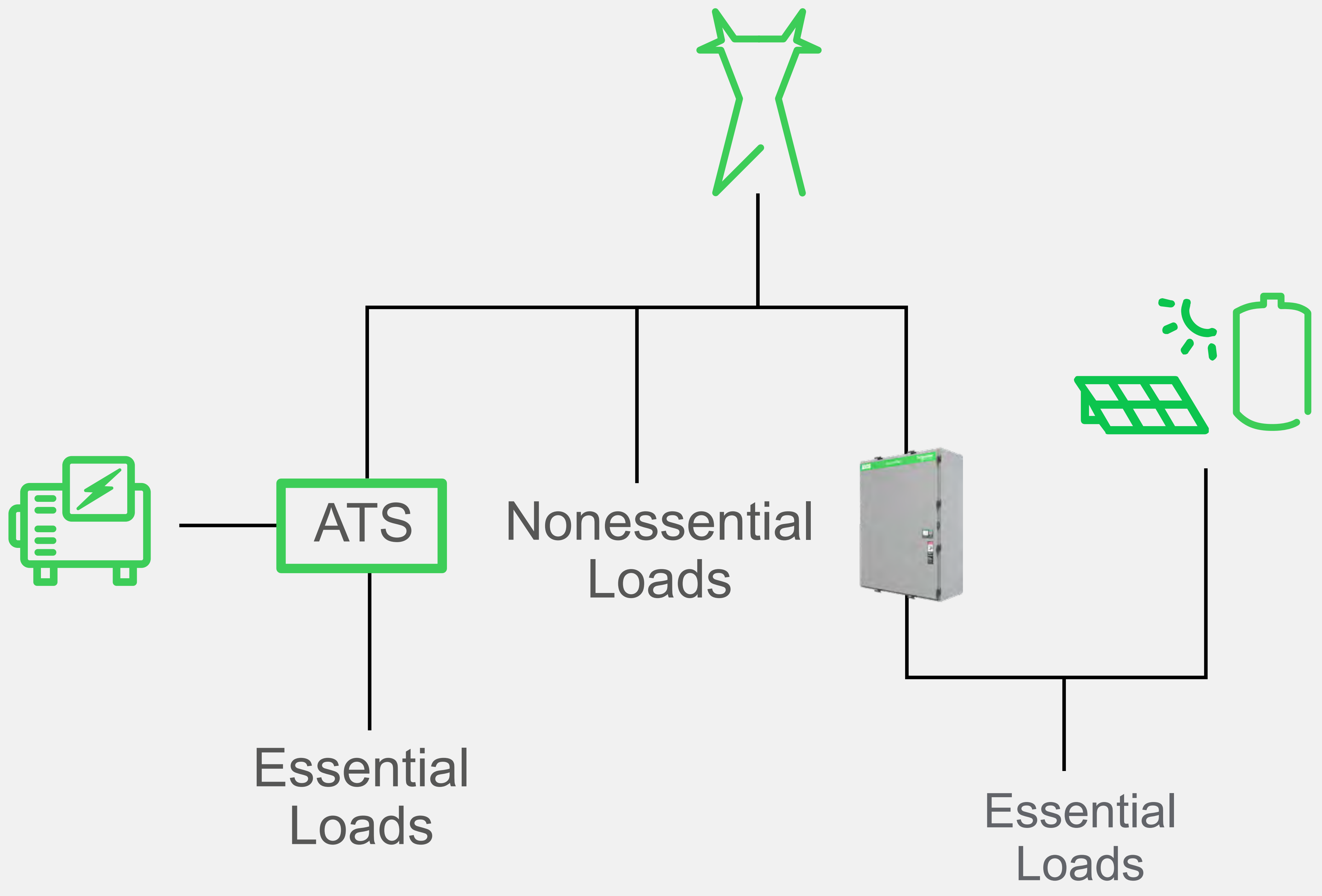


A SourcePacT unit is located between essential and nonessential loads.

Applications (cont.)

Battery and Generator Together – When an existing facility is expanded, stakeholders may choose energy optimization systems like BESS and solar to serve the new portion of the facility. In this case, SourcePacT may only isolate the new inverters and use batteries to feed their new essential loads while a generator supplies its existing and distinct essential loads. The sources run simultaneously to supply their respective loads – the generator for as long as it can be fueled and the BESS until reserve power is exhausted.

This scenario positions stakeholders to optimize energy costs for the new portion of their facility. Its disadvantage is that there is no additional redundancy for BESS-supplied essential loads after the battery reserve is consumed.

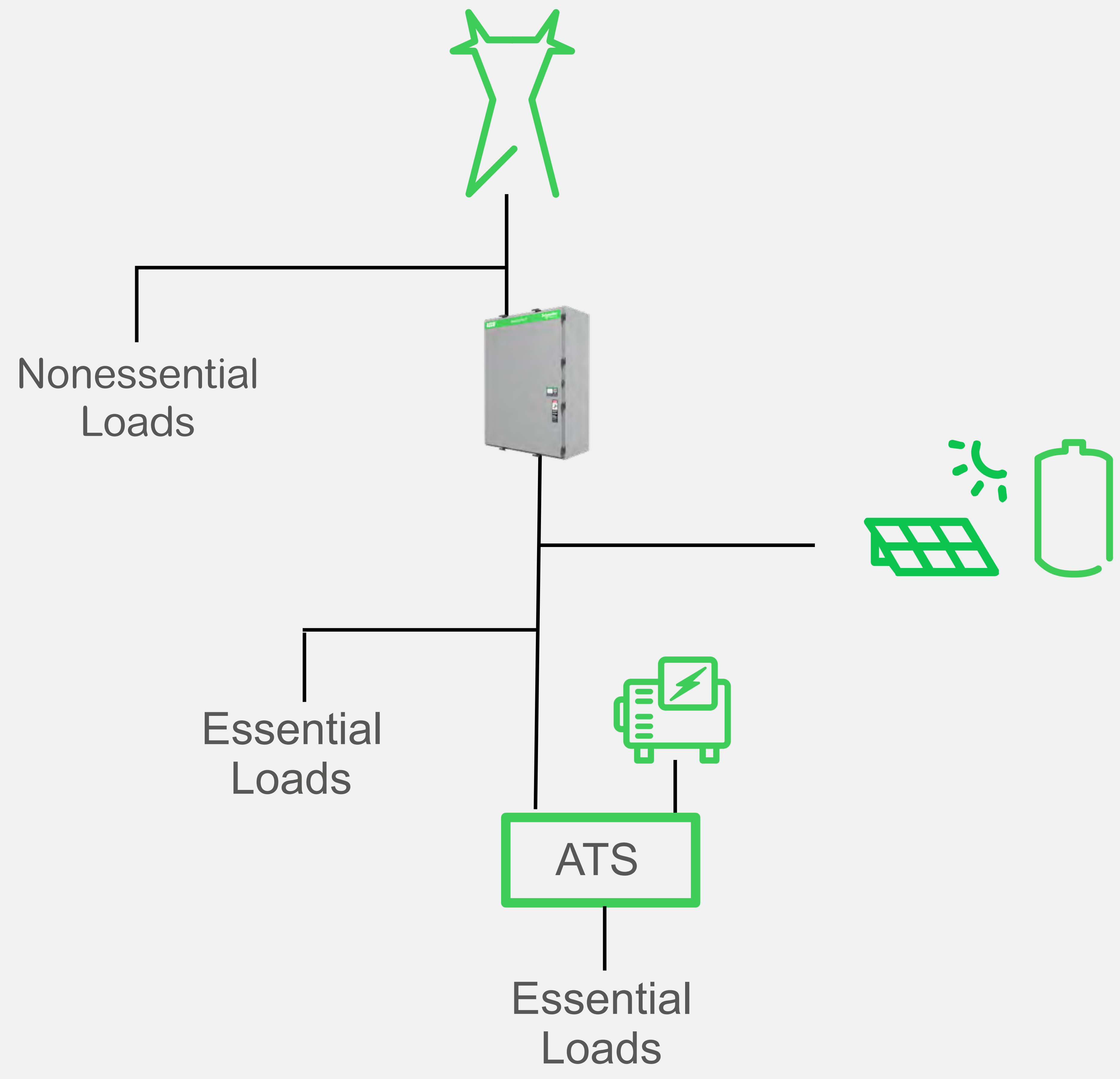


SourcePacT in a battery and generator system.

Applications (cont.)

Battery First – In many applications, stakeholders will seek to maximize BESS benefits without forgoing the long-term resilience offered by backup generators. Since most utility outages are typically short, a BESS can offer sufficient capacity to increase resilience for many outages. For longer events, generators supply backup power for as long as they can be fueled. In this configuration, a genset will be connected when needed through a transfer switch located downstream of the SIS.

By using batteries first for every outage, facilities will reap the majority of cost and sustainability benefits offered by energy storage, including energy cost optimization. By running generators only after stored energy is exhausted, facilities retain the extended power resilience benefits of conventional generators while reducing their size, runtime, operating cost, and environmental impact.



A Battery First configuration.

Summary

Summary

By properly isolating inverter-controlled power sources and essential loads from utility feeds, SourcePacT provides the ability to switch between grid-following and grid-forming modes. This enables facilities to use inverter-controlled sources to supply backup power for essential loads. SourcePacT provides proper isolation in a standardized, pre-integrated, single-device solution that is the first designed to the new UL 3008 outline. SourcePacT enables designers, integrators, contractors, and users to streamline the deployment of compliant grid/inverter isolation to reap all the cost, resilience, and sustainability benefits promised by distributed energy resources.

To learn more about power source management and using BESS for backup power, download the new ASCO white paper *SourcePacT Source Isolation Switch Basics*. For further information, visit the SourcePacT webpage, email ASCO Customer Care at customerservice@asco.org, or contact a local ASCO representative.

To learn more about
ASCO Source**PacT** visit

ascopower.com/sourcepact

blog

ASCO Power Technologies - Global Headquarters
160 Park Avenue
Florham Park, NJ 07932
Tel: 800 800 ASCO

998-xxxx