SPOC
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TECHNOLOGIES™

EXPLORING THE DIFFERENCE BETWEEN **HYBRID AND ALL-ELECTRIC POWER SYSTEMS**

We're going through a time of revolutionary change as the world moves power-generation processes that rely on diesel and gas toward electrification. While all-electric options are ideal in some instances, all electric power systems are not always practical or even feasible, much less the most cost-effective option. Given our current technology, there are applications that likely will never be all-electric.

That said, both all-electric and hybrid power systems are a significant improvement over traditional power systems fueled exclusively by fossil fuels. Industrial applications are some of the biggest producers of carbon emissions and both all-electric and hybrid power alternatives can reduce those emissions dramatically.

Hybrid power systems can enable quantum leaps in efficiency that otherwise would be impossible, say, through better engineering of a traditional genset. Hybrid systems allow us to take practical steps that dramatically cut our carbon output by slashing the amount of fuel we burn.

As applications move away from carbon-fueled power systems, the transition to either all-electric or hybrid, will be neither smooth nor linear, because what works well in one country or for one application won't necessarily work well for another..

That said, electric and hybrid power systems each have their advantages and the choice between the two typically comes down to distinct attributes of the specific system designs.

HYBRID POWER SYSTEMS IN INDUSTRIAL APPLICATIONS

Advantages

- ***Extended Range:*** Hybrid systems can provide continuous power for longer durations, making them suitable for industrial machinery that operates for extended periods.
- ***Fuel Flexibility:*** In industrial settings where electricity may not be readily available or practical, hybrid systems can use conventional fuels like diesel or gasoline, providing flexibility in energy sourcing.
- ***Power Output:*** Hybrid systems can offer high power output, making them suitable for heavy-duty industrial applications such as construction equipment, mining machinery, or large-scale generators.
- ***Efficiency:*** Hybrid systems can optimize power usage by switching between different energy sources based on demand, leading to improved overall efficiency.
- ***CAPEX ROI:*** A hybrid system burns less fuel by running expensive gensets and other power generation equipment less—dramatically less; often extending the life of those same gensets 10-, 15-, even 20-years.

Disadvantages

- ***Complexity:*** Hybrid systems are more complex than purely electric systems, involving additional components such as internal combustion engines, generators, and energy storage systems, which can increase maintenance requirements and operational complexity.
- ***Cost:*** The upfront cost of hybrid systems, including the integration of multiple power sources and associated components, can be higher compared to conventional power solutions.
- ***Emissions:*** While hybrid systems may be more fuel-efficient than traditional combustion engines, they still create emissions, say, when the generator is running.
- ***Dependence on Fossil Fuels:*** Hybrid systems that rely on conventional fuels perpetuate dependence on fossil fuels, which may not align with the sustainability goals of some sectors.

ALL-ELECTRIC POWER SYSTEMS IN INDUSTRIAL APPLICATIONS:

Advantages

- ***Zero Emissions:*** All-electric power systems produce zero emissions during operation, making them environmentally friendly and suitable for industrial settings where air quality is a concern.
- ***Lower Operating Costs:*** Electric motors are generally more energy-efficient than internal combustion engines, resulting in lower operating costs over the long term, especially as electricity prices continue to decline.
- ***Simplified Maintenance:*** Electric motors have fewer moving parts compared to combustion engines, leading to reduced maintenance requirements and downtime in industrial applications.
- ***Quiet Operation:*** Electric power systems operate quietly, which can be advantageous in noise-sensitive industrial environments or urban areas.

Disadvantages

- ***Limited Range:*** All-electric power systems may have limited range compared to hybrid systems, which could be a limitation for industrial machinery that needs to operate over large areas without frequent recharging.
- ***Energy Density:*** For many applications, all-electric power systems are not feasible because the size of the battery necessary to run the operation will be completely impractical.
- ***Charging Infrastructure:*** Industrial facilities may require significant investment in charging infrastructure to support all-electric equipment, which could be a barrier to adoption in some cases.
- ***Initial Investment:*** The upfront cost of transitioning to all-electric equipment, including purchasing electric machinery and establishing charging infrastructure, can be substantial.
- ***Power Grid Constraints:*** Large-scale adoption of all-electric industrial equipment could place additional strain on local power grids, requiring upgrades to accommodate increased demand.
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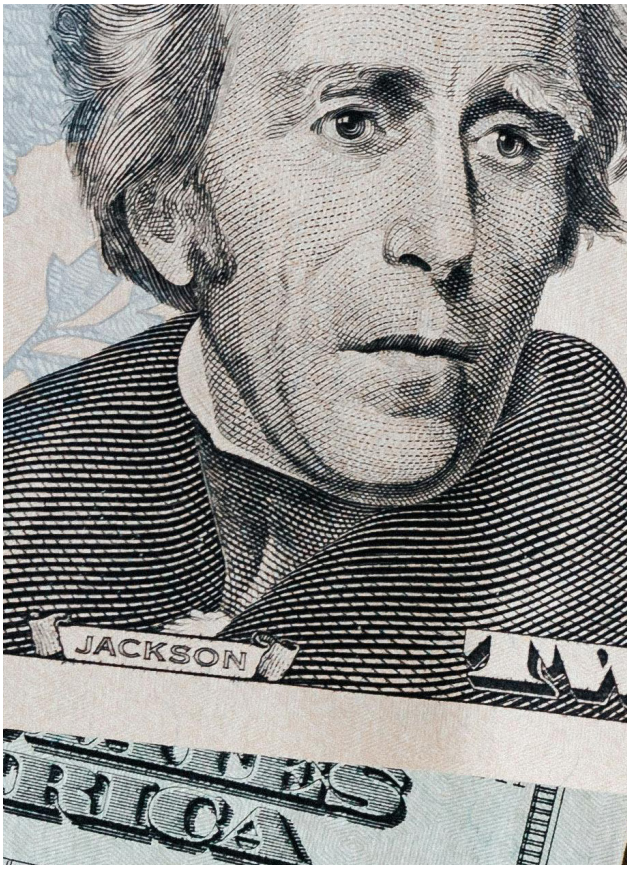
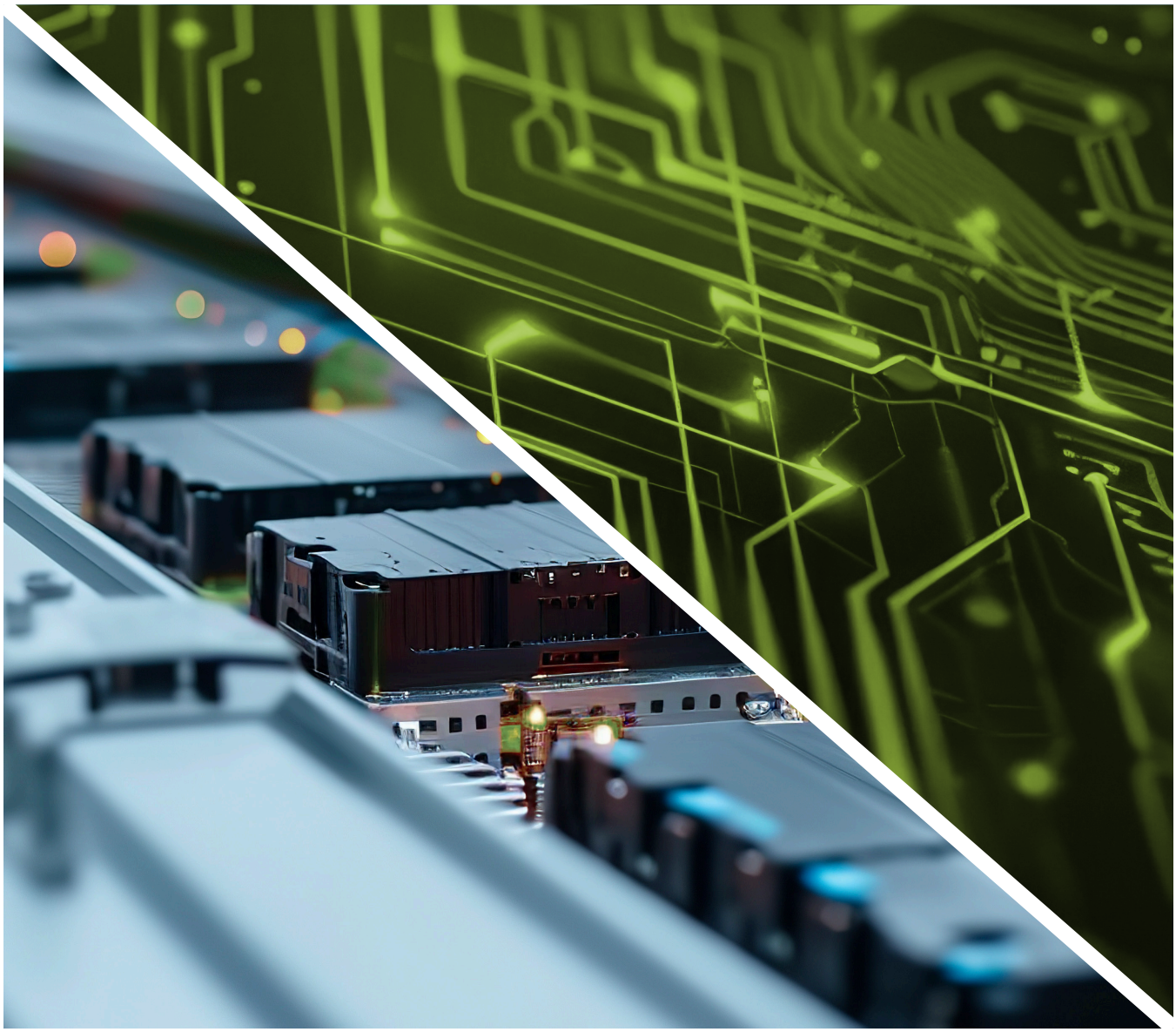
WHEN TO CHOOSE ONE OVER THE OTHER:

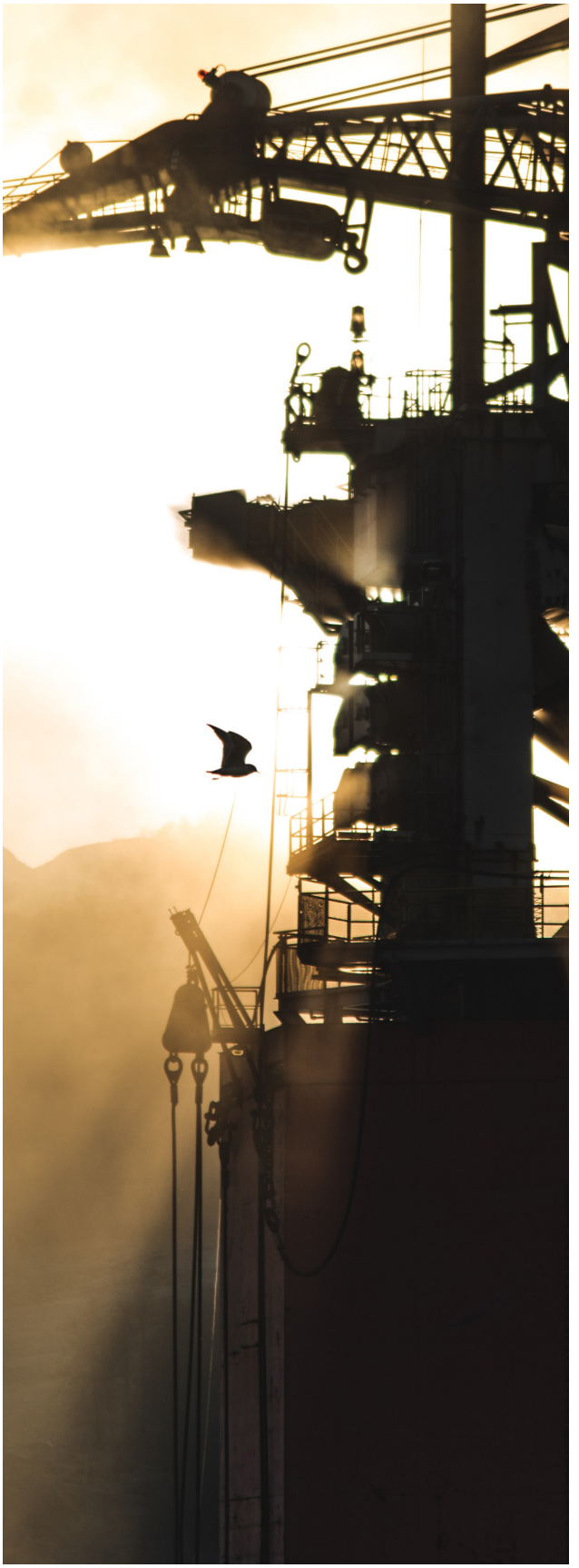
- ***Energy Availability:*** In regions with abundant renewable energy resources and well-developed electric infrastructure, all-electric power systems may be the preferred choice due to their environmental and efficiency benefits.
- ***Range and Flexibility:*** Applications requiring extended range or operating in remote areas with limited access to electric charging infrastructure may benefit more from hybrid power systems that offer fuel flexibility and extended range.
- ***Cost Considerations:*** The upfront cost and operational expenses associated with each system should be carefully evaluated based on factors such as fuel prices, maintenance costs, and government incentives or subsidies for renewable energy adoption.
- ***Specific Applications:*** Certain applications, such as urban transportation or short-haul delivery vehicles, may be better suited for all-electric power systems due to their lower emissions and operational costs, while others, like long-haul trucks or off-grid power generation, may benefit more from hybrid solutions that offer extended range and fuel flexibility.



MAKING THE MOST OF MULTIPLE ENERGY SOURCES WITH HYBRID POWER SYSTEMS

Transitioning from fossil fuels to alternative energy sources is becoming increasingly critical because of both practical and political forces driving change in the world. Hybrid power systems that incorporate multiple energy sources, from traditional gensets to alternative sources, and energy storage have emerged as an ideal solution for many applications. Advances in energy storage and power conversion technology have pushed back the boundaries of 'what's possible' with hybrid systems—meaning that hybrid technology is changing the landscape of entire industries.





For example, many critical applications such as data centers, telecommunications and essential infrastructure cannot go dark.

For those systems, reliable power is no luxury, and hybrid back-up systems that integrate energy storage with other sources enhance the reliability of their generator sets.

In this way, hybrid systems provide many benefits.

- They can generate power on location (island mode) or as a component of a decentralized electricity group, often incorporating multiple power sources from gensets to alternative wind and solar systems.
- The ability to switch between the island and connected modes allows for a more secure power supply.
- Hybrid systems increase reliability for rural communities that are too far away from centralized power generation.
- Field data suggests that once the batteries in a hybrid system are charged, in some applications, the genset can be turned off for 8, 10, 12 hours at a time. Not only does this save on fuel costs and reduce emissions, it greatly extends the life of the genset, extending its lifetime ROI.

INTEREST AND INVESTMENT IN HYBRID POWER SYSTEMS IS ON THE RISE GLOBALLY, WITH MULTIPLE FACTORS DRIVING GROWTH, SUCH AS:

- The rising prices of gas and electricity.
- The need to decarbonize.
- Transformation of traditional grid infrastructure to keep up embedded generation growth.
- Hybrid systems are cost-effective and provide quick return on investment.
- In many cases, renewable energy sources are now more cost effective than fossil fuels from a marginal cost of production and an operational and maintenance perspective, according to the International Renewable Energy Agency.
- Battery storage systems allow for additional value, as they firm renewable generation assets and facilitate dispatchability.

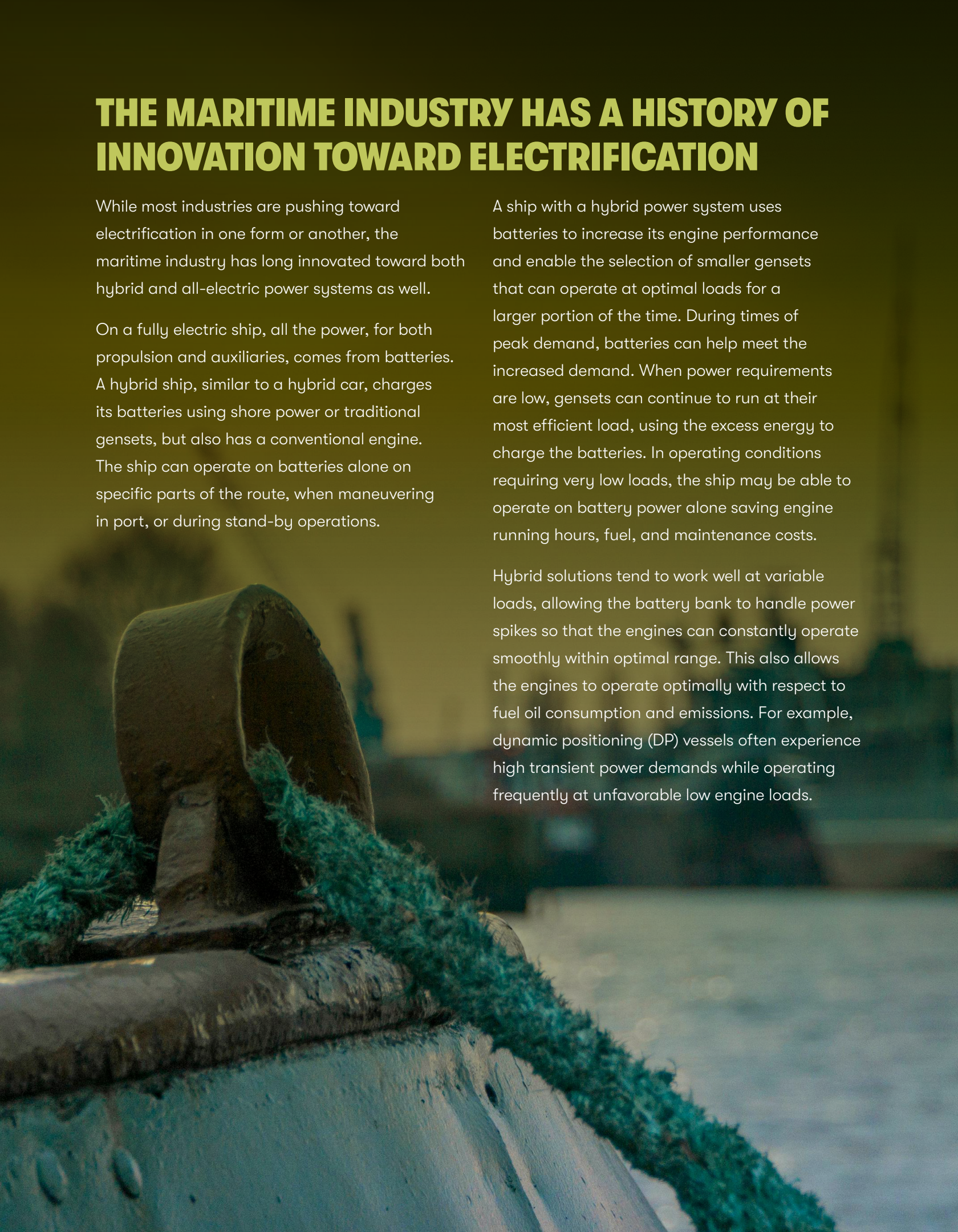
THE MARITIME INDUSTRY HAS A HISTORY OF INNOVATION TOWARD ELECTRIFICATION

While most industries are pushing toward electrification in one form or another, the maritime industry has long innovated toward both hybrid and all-electric power systems as well.

On a fully electric ship, all the power, for both propulsion and auxiliaries, comes from batteries. A hybrid ship, similar to a hybrid car, charges its batteries using shore power or traditional gensets, but also has a conventional engine. The ship can operate on batteries alone on specific parts of the route, when maneuvering in port, or during stand-by operations.

A ship with a hybrid power system uses batteries to increase its engine performance and enable the selection of smaller gensets that can operate at optimal loads for a larger portion of the time. During times of peak demand, batteries can help meet the increased demand. When power requirements are low, gensets can continue to run at their most efficient load, using the excess energy to charge the batteries. In operating conditions requiring very low loads, the ship may be able to operate on battery power alone saving engine running hours, fuel, and maintenance costs.

Hybrid solutions tend to work well at variable loads, allowing the battery bank to handle power spikes so that the engines can constantly operate smoothly within optimal range. This also allows the engines to operate optimally with respect to fuel oil consumption and emissions. For example, dynamic positioning (DP) vessels often experience high transient power demands while operating frequently at unfavorable low engine loads.



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SPOC Believes in Hybrid Power Systems

We're going through a time of revolutionary change as the world moves processes powered by diesel and gas generators toward electrification. While the all-electric option may work in some instances, it's rarely the most practical or cost-effective.

At SPOC Grid Inverter Technologies, we have the technology, knowledge, experience, and expertise in a broad array of energy storage chemistries to help build hybrid solutions with smarter, better-performing hybrid power systems.

Contact us to speak to an expert who can help you get started on your own electrification journey.