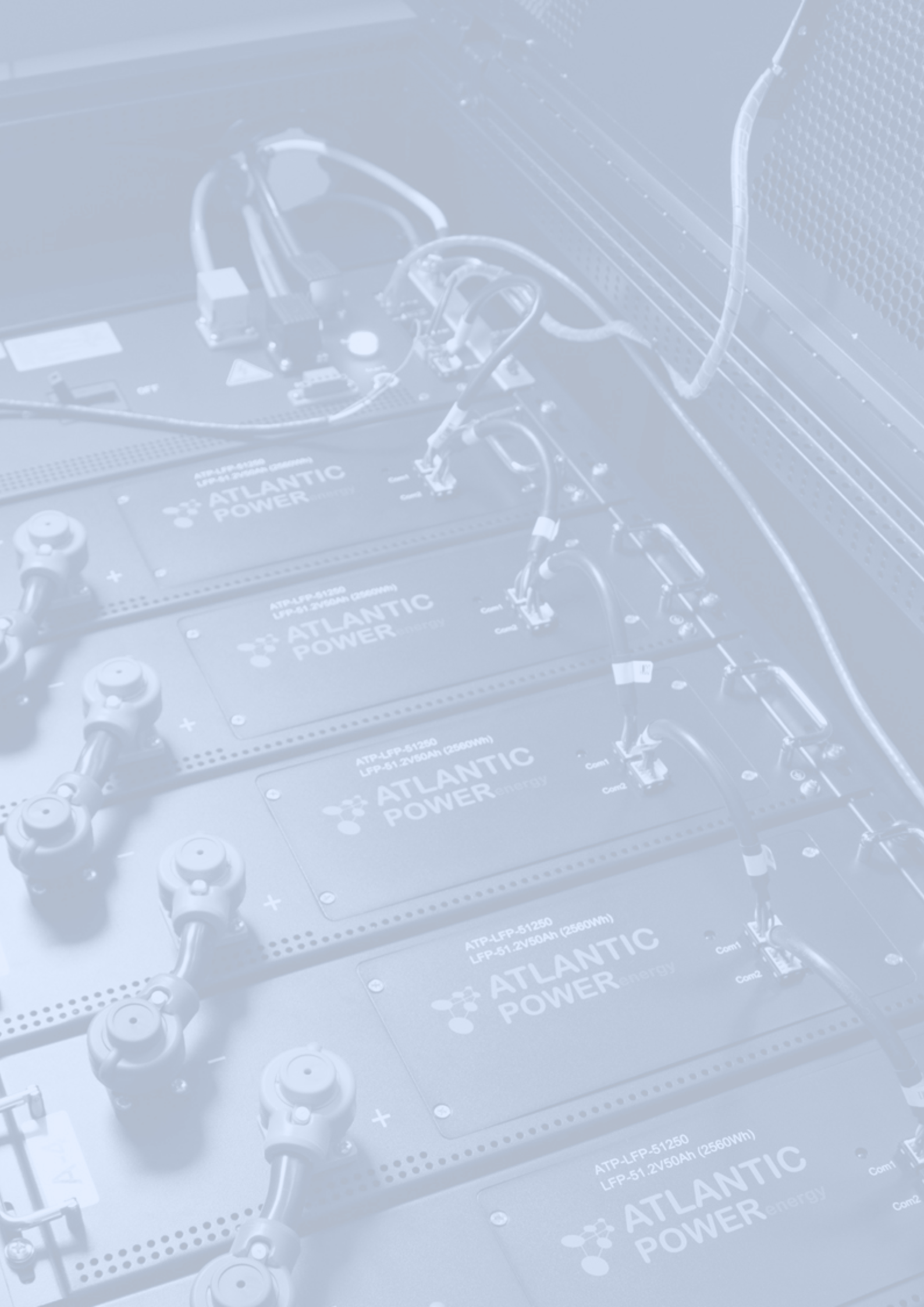




LITHIUM-ION BATTERIES AS AN ALTERNATIVE TO GROWTH IN GLOBAL ENERGY DEMAND



ATP-LFP-51250
LFP-51.2V50Ah (2560Wh)
ATLANTIC POWER energy

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INTRODUCTION

In recent decades, the sustained growth of global energy demand has imposed significant challenges for the sustainability and efficiency of energy systems. Fossil fuels continue to be the most widely used. However, the transition to renewable energy sources, such as solar and wind, is already an identified need, accompanied by efficient and reliable energy storage solutions.

It is estimated that by 2050, renewable energies should grow almost eight times with respect to the current participation, and in this way be able to reach the goal of zero emissions proposed by the United Nations (UN).

In this context, lithium-ion batteries have emerged as a key technology to support these “clean” generation systems, covering the energy storage needs for their subsequent use.

Keywords: Lithium ion, LFP, solar energy, wind energy, zero emissions.

GLOBAL ENERGY DEMAND

Economic growth and the increase in the world's population have driven a significant increase in energy demand. According to the International Energy Agency (IEA), global energy demand is expected to increase by 30% by 2040, posing a formidable challenge to today's energy systems (IEA, 2019). The need to reduce greenhouse gas emissions and dependence on fossil fuels has led to an increase in investment and development of renewable energy technologies. However, the intermittent nature of these renewable sources requires advanced energy storage solutions to ensure a continuous and stable supply.

The main sources of energy globally continue to be fossil fuels, with oil accounting for 29%, coal 27% and natural gas 24%. The global economy

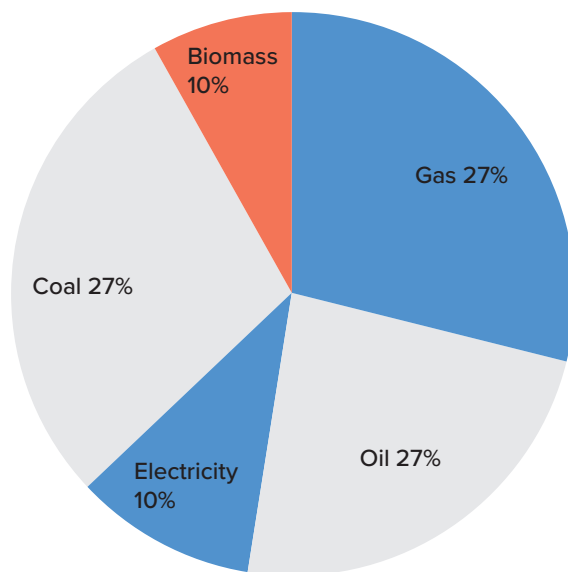


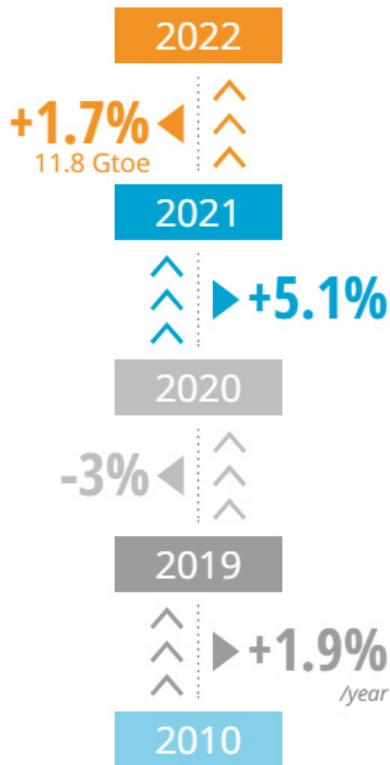
Figure 1.
Energy sources participation
Source: Enerdata

returned to its growth trend with an increase of 3.2%, although China experienced a slowdown due to its “zero emissions” policy.

CO₂ emissions also increased by close to 2%, due to higher coal consumption in the last two years, moving away from the goal of keeping global warming below 2°C. Renewable energy production, on the other hand, continued its expansion, with solar growing by 27% and wind by 13%.

In summary, 2022 showed a return to pre-COVID-19 pandemic trends. Nonetheless, concerns about the long-term impact of the Russia-Ukraine conflict on the global energy landscape remain relevant.

ENERGY CONSUMPTION grows at historic pace



CO₂ EMISSIONS** rise above 2019 levels

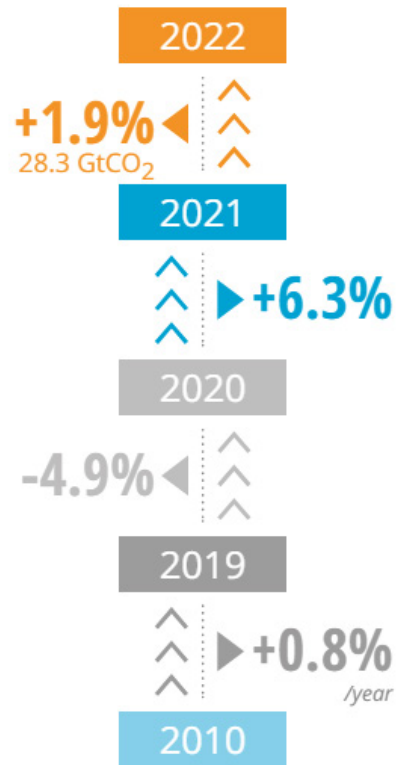


Figure 2.
Growth in energy consumption and CO₂ emissions
Source: Enerdata

**RENEWABLE ENERGY
GENERATION, MAINLY WIND AND
SOLAR, WILL ACCOUNT FOR 38%
OF THE GLOBAL ENERGY MIX BY
2030 AND 62% BY 2050.**

LFP LITHIUM-ION BATTERIES



Figure 3.
Atlantic Power LFP Lithium Ion Battery

Lithium-ion batteries, introduced commercially in the 1990s, have revolutionized energy storage thanks to their high energy density, charge/discharge efficiency, and long lifespan (Goodenough & Kim, 2010). Within the lithium-ion battery variants,

lithium iron phosphate (LFP) batteries have gained prominence due to their increased safety, long lifespan, and thermal stability, making them particularly suitable for energy-intensive applications (Nitta et al., 2015). The main characteristics of Lithium-Ion batteries are:

- **Chemical Composition:** LFP (Lithium-Iron Phosphate) batteries are composed of a lithium iron phosphate (LiFePO_4) cathode, which gives them several advantages in terms of safety, lifespan and thermal performance.
- **Safety:** LFP batteries are known for their excellent safety. The chemical structure of LiFePO_4 is very stable, which minimizes the risk of explosion or fire even under extreme conditions, such as overload or short circuit.
- **Long Life:** One of the most outstanding features of LFP batteries is their long-life cycle. These batteries can reach over 2000 charge and discharge cycles with a holding capacity of over 80%, making them ideal for long-term applications.
- **Thermal Stability:** LFP batteries offer great thermal stability, operating efficiently over a wide range of temperatures. This makes them suitable for use in various environmental conditions without degrading quickly.

- **Energy Density:** Although LFP batteries have a slightly lower energy density compared to other lithium batteries, such as NMC (Nickel-Manganese-Cobalt), they offer sufficient energy density for many stationary and mobile applications, up to 120Wh/Kg.
- **Environmental Impact:** LFP batteries are more environmentally friendly compared to other lithium batteries, due to the absence of cobalt, a material that presents ethical and environmental challenges in their extraction.

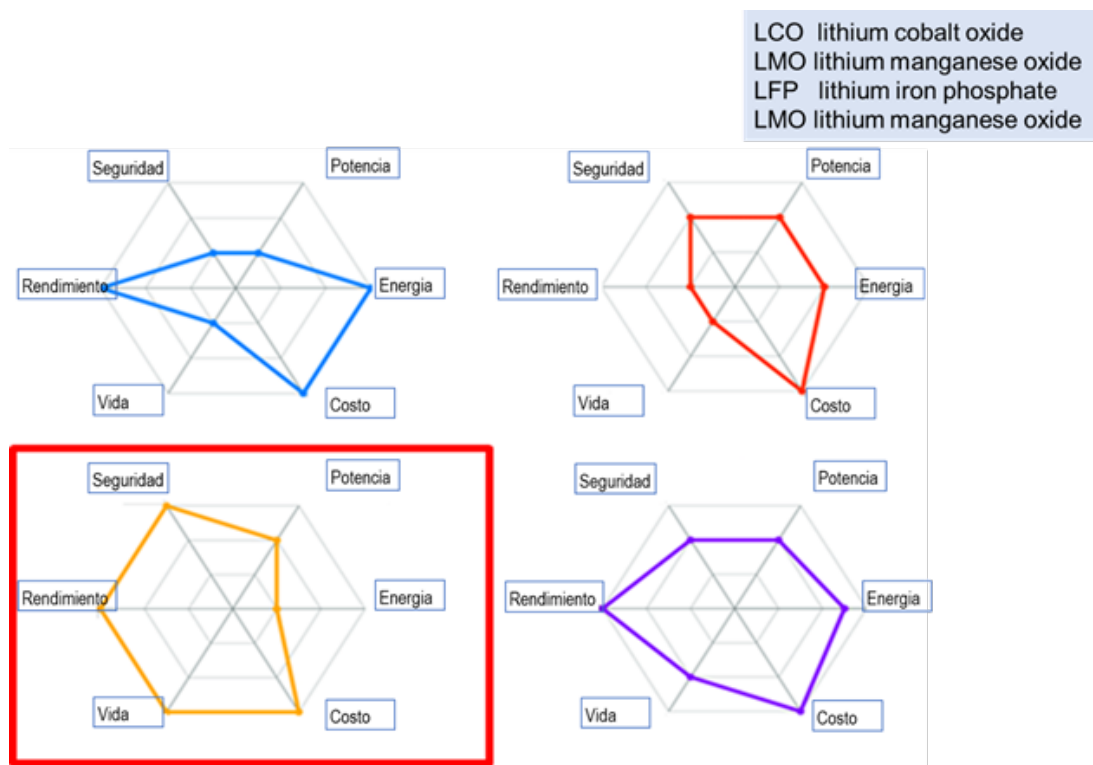


Figura 4.
Comparison of Technologies Lithium Batteries

APPLICATIONS OF LITHIUM-ION BATTERIES

LFP batteries are used in a wide range of sectors, including energy storage for power grids, electric vehicles, telecommunications, and uninterruptible power supplies (UPS) in critical facilities. In the datacenter sector, for example, these batteries provide a reliable solution for maintaining operational continuity during power outages and fluctuations in power supply (Tarascon & Armand, 2001).

Another of the great applications and that is an alternative for utility companies, are the BESS (Battery Energy Storage System) systems that allow storing electrical energy in batteries for later use. These systems use batteries of various chemistries, with lithium-ion (Li-ion) being the most common due to their high energy density, efficiency, and durability.

The main components of a BESS system are:

- **Batteries:** The central component that stores energy.
- **Inverters:** Converts the direct current (DC) stored in the batteries to alternating current (AC) for use in the power grid.
- **Battery Management System (BMS):** Monitors and controls the state of charge, temperature, and other parameters of the batteries to ensure safe and efficient operation.
- **Energy Management Software (EMS):** Optimizes the use of stored energy, managing charging and discharging based on energy demand and prices.
- **Cooling systems:** They keep batteries at an optimal temperature to maximize their lifespan and efficiency.

BESS systems are an essential tool for power generation companies, as they not only improve grid stability and reliability, but also optimize costs and contribute to environmental sustainability. Their ability to integrate renewables and respond quickly to market demands makes them a crucial solution to meet the energy challenges of the future.

BESS have significant applications in the utility power supply, transmission, and distribution sectors. The most relevant application scenarios in each of these sectors are summarized below:

Power Supply

- **Generation Support:** BESS allows power plants to store excess energy produced during periods of low demand for use during peak demand, improving operational efficiency and reducing the need to spin up additional power plants.
- **Renewable Energy Integration:** They facilitate the integration of intermittent renewable energy sources (such as solar and wind) by storing energy when generation is high and releasing it when it is low, ensuring a continuous and stable supply.
- **Emission Reduction:** By improving efficiency and allowing greater use of renewable energies, BESS contribute to the reduction of greenhouse gas emissions, aligning with sustainability objectives.

Power Transmission

- **Frequency Regulation:** BESS can respond quickly to fluctuations in grid frequency, providing regulation services that maintain grid stability and prevent blackouts.

- **Congestion Relief:** During periods of high demand, BESS can release stored energy to relieve congestion on transmission lines, improving the efficiency of the transmission system.
- **Operational Reserve:** They function as an operational reserve that can be activated quickly in the event of generation failures or unexpected peaks in demand, improving the resilience of the electricity system.

Power Distribution

- **Demand Management:** BESS allows distribution companies to manage energy demand more effectively, storing energy during periods of low demand and releasing it during peak consumption.
- **Quality of Service Improvement:** They help maintain the quality of the electrical supply by providing a reliable and stable power source, minimizing interruptions and voltage fluctuations.
- **Microgrids and Distributed Energy:** BESS are essential for the operation of microgrids and distributed energy systems, allowing local communities to manage their own energy generation and consumption autonomously and sustainably.

ATLANTIC POWER ENERGY LFP BATTERIES

With more than 15 years of experience in the industry, Atlantic Power stands out as a leading manufacturer of UPS, precision air conditioners, VRLA and Lithium-ion batteries, MV generators, switches and reclosers, datacenter infrastructure, and asset monitoring. With an extensive track record of delivering reliable and efficient power solutions throughout North, Central, and South America, as well as the Caribbean, our company prides itself on offering not only high-quality and efficient products, but also exceptional technical service that ensures customer satisfaction at all stages of the process, from initial consultation to installation and ongoing maintenance.

Our ATP Lithium Ion LFP batteries stand out in the market over other brands, and are the right choice for your steady-state backup and storage systems.

Advanced Technology

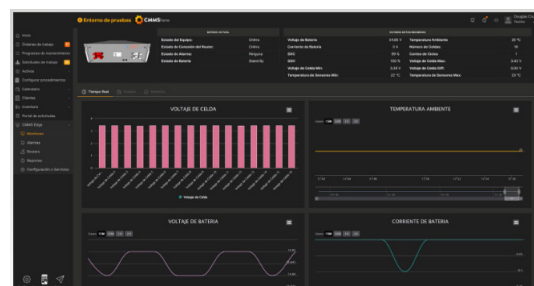
Atlantic Power uses state-of-the-art technology in the manufacture of its LFP batteries, ensuring hi-

gh-quality products and superior performance. The company constantly invests in research and development to stay at the forefront of energy storage innovation.



Reliability and Durability

Atlantic Power batteries are renowned for their reliability and durability. Thanks to their chemical composition and robust design, they offer consistent and safe performance, suitable for critical applications such as telecommunications and emergency power systems.



Service & Support

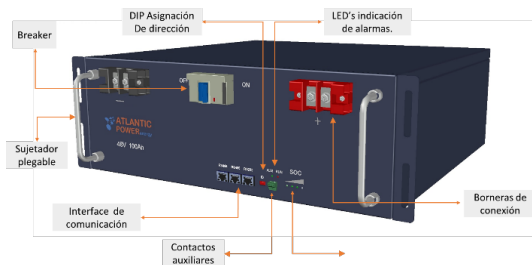
Atlantic Power is distinguished by its excellent customer service and

technical support. They offer expert advice and customized solutions to maximize the efficiency of your products in various applications.



Commitment to Sustainability

The company is committed to sustainability, using materials and processes that minimize environmental impact. Atlantic Power's LFP batteries are recyclable and meet strict environmental standards.



Innovation and Customization

Atlantic Power offers customized solutions that are tailored to the specific needs of its customers. Their ability to design bespoke energy storage systems is a significant advantage in today's competitive market.



Reduced Operating Costs

Atlantic Power's LFP batteries help reduce long-term operating costs thanks to their long life and low maintenance. This makes them a cost-effective investment for any project that requires efficient and reliable energy storage.



Monitoring with CMMSedge

With our CMMSedge platform, you can monitor ATP Lithium-Ion batteries and other assets within your infrastructure.



Our equipment is renowned for its high reliability and low failure rate, making it the preferred choice for a wide range of critical applications in various industries. At Atlantic Power, we are committed to providing cutting-edge power solutions that exceed our customers' expectations and ensure the continuity of their operations at all times.

We continue to innovate to provide our customers with state-of-the-art products and with the best standards of safety, quality and efficiency.

For more information, visit us at www.atlanticpowerenergy.com

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