Bloomenergy®

BROCHURE

The Bloom Energy Server®

Resilient. Predictable. Sustainable.

Powering our planet with resilient, sustainable, and predictable energy is the defining challenge of our time. A world leader in fuel cell power generation, Bloom's Energy Server has been deployed in the market since 2008 and provides the most efficient power to customers using fuel cell technology. The Energy Server is fuel-flexible and can generate energy using natural gas, blended hydrogen, biogas, or hydrogen.

The Energy Server system has a small modular footprint with unlimited scalability. It can quietly and efficiently generate enough power to serve any land-based stationary power need and provide power for marine vessels at sea. Bloom's solid oxide Energy Server platform operates at a core temperature above 800°C. It has been optimized to distribute, consume, and utilize feed fuel better than any commercially available Solid Oxide Fuel Cell (SOFC) product worldwide. Bloom's Energy Server has an industry-leading average lifetime electrical efficiency of 54%. Unlike wind and solar, it has the added benefit of being always available and predictable for customers.

When used with a Combined Heat and Power (CHP) system, the Energy Server can reach an average lifetime combined electrical and thermal efficiencies of greater than 90%, maximizing the energy from the feed fuel and decreasing energy waste and harmful emissions. Bloom Energy has a 1 GW manufacturing capacity and over 1.2 GW in deployed capacity worldwide, with installations in data centers, semiconductors, retail, manufacturing, hospitals, utilities, food & beverage, and oil & gas.

Bloom's Energy Server

- **Combined electrical & thermal efficiency of >90%**
- **Hydrogen ready and fuel flexible platform**
- **Scalable design with unlimited power generation capability**
- **Over 1.2 GW systems deployed**
- **1 GW manufacturing capacity**

What makes up an Energy Server System?

The Energy Server is comprised of various identical-looking modules, each with a unique function in delivering clean power to customers. Figure 1 shows the components and operation of a 325 kW Energy Server.

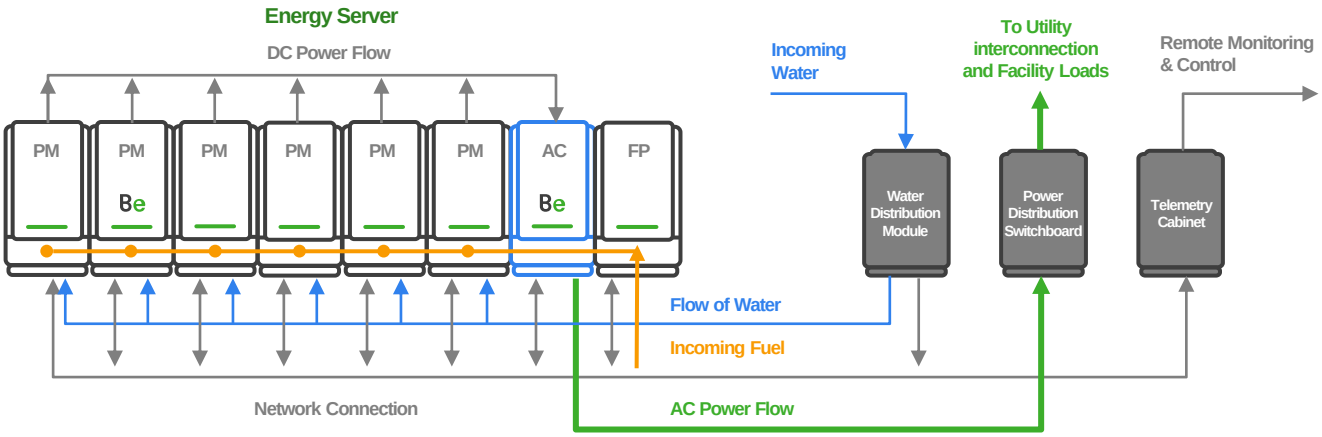
- **The Power Module (PM):** Contains the solid oxide fuel cell stacks that convert fuel into DC power through electrochemical means, without combustion. The PM also has DC/DC modules that regulate the output DC voltage.
- **The Fuel Processing module (FP):** The FP is an entry point for incoming fuel. It receives the fuel, removes any impurities, and distributes the gas to the PMs.
- **The inverter module (AC):** Converts the DC power from the PMs into usable AC power. Depending on the project's needs, this power is then delivered to customer loads or utility lines.

Energy Server System Operation

Bloom offers the following auxiliary equipment as part of the complete power delivery solution.

- **Telemetry Cabinet (TC):** For remote monitoring of the Bloom Energy equipment.
- **Water Distribution Module (WDM):** To supply water to the PMs during start-up.
- **Power Distribution Switchboard (PDS):** To make electrical connections to the electrical services at the site.

Figure 1: 325 kW Energy Server Flow Diagram



The Energy Server is available in a linear configuration and can be installed back-to-back if required (*see Figure 3*). It may also be mounted vertically in a Bloom Power Tower configuration if real estate is limited. To aid in project execution, the Energy Server is often packaged at the factory and mounted on a pre-wired skid containing all the interconnecting cables, pipes, and auxiliary equipment. This packaged Energy Server (*Figure 2*) makes installation fast and easy, avoiding any potential delays caused by unknown underground site conditions that could exist below grade.

Figure 2: Packaged Energy Server front and side view

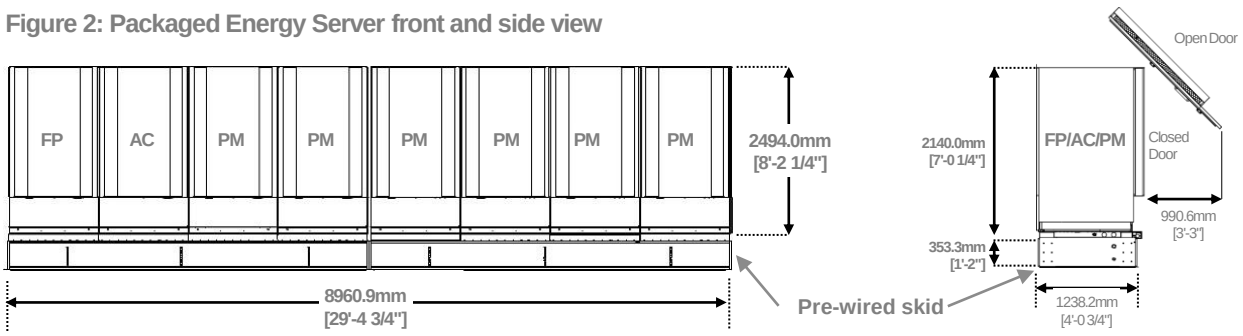
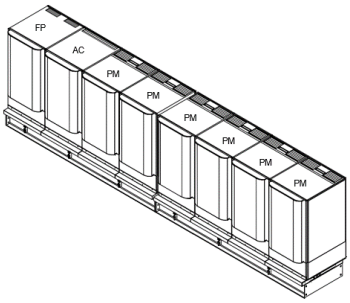
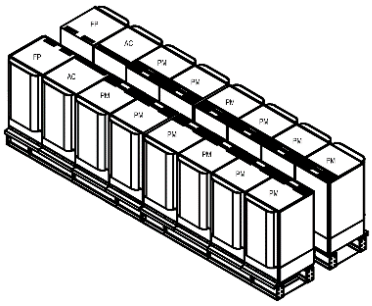


Figure 3: Linear and back-to-back configuration of the Energy Server



325 kW Energy Server Linear Configuration



2 x 325 kW Energy Server Back-to-Back Configuration

As customers evaluate their energy needs, it is important to note that Bloom's Energy Server is fuel-flexible, highly efficient, and designed to be future-proof as cleaner fuel sources become readily available. *Table 1* below highlights the technical performance of an Energy Server optimized for natural gas. Each deployed Energy Server is fully monitored and maintained by Bloom Energy with an uptime of up to 99.998%, and each customer is provided with a BloomConnect® customer portal to monitor system performance.

Table 1: 325 kW Energy Server - Technical Specifications

Energy Server Technical Highlights	
Electrical output	325 kW, 480/415/400/380 V, 3-ph, 3W and 4W, 50/60 Hz
Fuel input[1]	Natural Gas
Cumulative electrical efficiency	65 - 53% (LHV net AC)
Heat rate (HHV)	5,811 – 7,127 Btu/kWh (6,131 – 7,519 kJ/kWh)
Average lifetime efficiency w/ thermal	>90% (exhaust heat available @ >350 ºC)
CO_2 emissions @ state efficiency	679 - 833 lbs/MWh (308 – 378 kg/MWh)
Nox	0.003 lbs/MWh (0.001 kg/MWh)
Sox	Negligible
CO	0.013 lbs/MWh (0.005 kg/MWh)
Noise levels	<65 dBA @ 10 ft (3 m)
Operating temperature	-20 ºC to 45 ºC
Enclosure type	Outdoor[2]
Altitude	<2,000 m
Seismic rating	ASCE7 SDC (Seismic Design Category) D
Weight (w/skid)	31,926 lbs (14.8 mt)
Dimensions (w/skid)	29’5” x 4’4” x 8’2” (9 m x 2.5 m x 1.3 m)
Safety	FC1, UL 1741, UL 1998, CE, KESCO
Utility interaction	IEEE 1547 2018, UL 1741 SB, CA Rule 21, CEI 016, KEPCO, G99, C10/11[3], VDE[3]
EMC	EN 55011/KN11, EN 61000, KN32, KN35
Data interface	Sunspec, Modbus, IEC 61850
External communication	CAN, Ethernet
Utility communication	IEEE 2030.5, DNP3

Notes:
1. Contact Bloom Energy for Energy Server operational performance data when operating on biogas, blended hydrogen, or hydrogen.
2. Contact Bloom Energy for indoor installations.
3. Certifications are expected to be available in 2024.

The Energy Server Solution as Primary Power

Many customers use the Energy Server to generate power and operate in parallel with the local grid to offset high energy costs. This Energy Server application can reduce customer scope 1 or 2 emissions. During primary power operation, if the grid becomes unavailable, the Energy Server will go into standby mode until grid power is restored, or it can operate in parallel with a backup diesel generator and reduce diesel consumption.

Bloom Energy has created Energy Server blocks that are repeatable and scalable. The most common base block for the global market is the 325 kW, as shown in Figure 1. With this 325 kW base block, the Energy Server is then duplicated and scaled to multiple megawatts to fit the needs of any project. There is no technical limit on the size of the Energy Server for primary power applications.

Primary Power applications are popular, but more customers are requesting increased flexibility and control with a microgrid. Bloom Energy will supply additional equipment to the site when customers choose any of its microgrid applications.

The Energy Server Solution with Microgrid

When a customer wants the Energy Server to play a more significant role in their energy strategy, Bloom offers microgrid options that allow the customer to leverage the Energy Server to take primary control over critical loads and customize power delivery.

Bloom Microgrid: The Bloom Microgrid provides a resilient solution to stay energized through power outages. The Energy Server in a Bloom Microgrid runs alongside the utility in grid-following mode, providing clean, sustainable, resilient energy while optimizing the customer's financials. In a grid outage, the Energy Server briefly disconnects from the utility and comes online in a grid-forming mode, carrying the load pre-determined by the customer. The Energy Server will maintain this load and resume grid parallel operation after restoring utility power.

Advanced Bloom Microgrid: The Advanced Bloom Microgrid provides uninterrupted premium quality power to keep critical loads online with no interruptions arising due to grid dips, spikes, noise, and outages. With the Advanced Bloom Microgrid, the Energy Server maintains power for the critical loads during power outages, shedding any non-critical loads until the power is restored. The Energy Server will continue to power critical loads and return to normal operation after the utility power is restored.

Bloom off-grid: The Bloom off-grid application offers a load-following solution where the Energy Server regulates the power generated following the site's load variations. The solution offers customers the option to work independently of the grid today and the readiness to connect to a utility in the future should the grid become available. When grid power is available, the customer can remain off-grid or reconfigure the Bloom off-grid solution to a Primary Power, a Bloom Microgrid, or an Advanced Bloom Microgrid configuration.

The Bloom Energy Server can be procured with a maintenance agreement as a CAPEX. Alternatively, it can be contracted as an energy service for 5-20 years through a Power Purchase Agreement (PPA) with a tolling rate. Bloom's Energy Server provides a resilient, predictable, and sustainable solution that can be quickly deployed for onsite power generation.

Bloom Energy Headquarters
4353 North First Street
San Jose, CA 95134 USA

bloomenergy.com

Flexible. Future Proof.

Accelerate your path to a zero-carbon future.

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