

The Bloom Energy Server[®]

Resilient, Predictable, Sustainable.

Bloom's Energy Server has been deployed in the market since 2008 and is one of the most efficient fuel cell based power generation products on the market today.

A world leader in fuel cell power generation, Bloom's Energy Server has a small modular footprint and can quietly and efficiently generate enough power to serve any land-based stationary power need as well as provide power for marine vessels at sea. Bloom's solid oxide Energy Server platform operates at a core temperature above 800°C and has been optimized to distribute, consume, and utilize feed fuel better than any Solid Oxide Fuel Cell (SOFC) product in the world.

The Bloom Energy Server has an industry leading average lifetime electrical efficiency of 54% and unlike wind and solar, have the added benefit of being always available and predictable for customers.

When used in conjunction with a Combined Heat and Power (CHP) system, the Energy Server can reach an average lifetime combined electrical and thermal efficiencies of 85%, maximizing the energy from the feed fuel and decreasing energy waste and harmful emissions.

By the end of 2022, Bloom Energy reached 1 GW in deployed capacity worldwide with installations in industries such as datacenters, semiconductor manufacturing, retail, hospitals, utilities, food & beverage, oil & gas among others.



Bloom Energy Server

- **Combined electrical & thermal efficiency of 85%**
- **Fuel flexible platform**
- **Scalable design with unlimited power generation capability**
- **1 GW systems deployed**
- **1 GW manufacturing capacity**

What makes up an Energy Server System?

The Energy Server is comprised of various identical looking modules; however each module has a unique function in delivering clean base power to customers. Figure 1 shows the layout and dimensions of a typical 330 kW Energy Server.

- **The Fuel Processing module (FP):** Receives the incoming fuel, removes any impurities, and distributes the gas to the Power Modules (PM)
- **The Power Module (PM):** Contains the solid-oxide fuel cell stacks that convert fuel into DC power through electrochemical means, without combustion.
- **The inverter module (AC):** Converts the DC power from the PMs into usable AC power. This power is then delivered to customer loads or utility line, depending on the need of the project.

The Energy Server can be installed in a linear or back-to-back configuration as shown in Figure 2 to match the site needs. 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 most often packaged at the factory, mounted on a pre-wired skid that contains all the interconnecting cables and pipes. This packaged Energy Server makes installation fast and easy, avoiding any potential delays caused by unknown underground site conditions that could exist below grade.

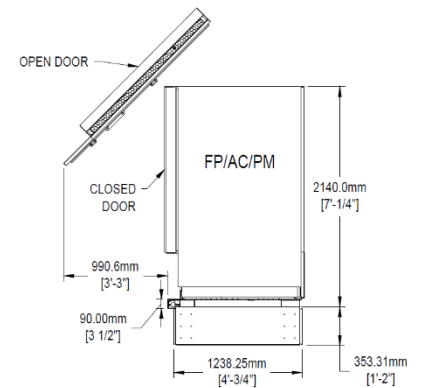
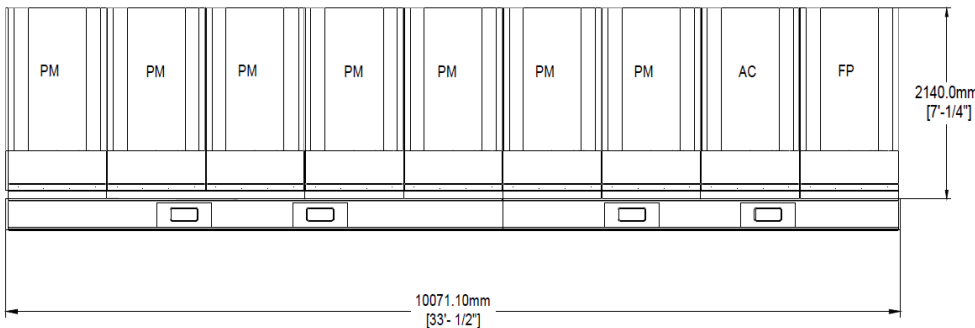
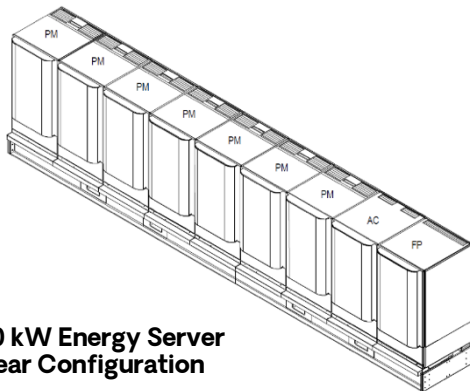


Figure 1: 330 kW packaged Energy Server base dimensions w/skid



330 kW Energy Server Linear Configuration



660 kW Energy Server Back-to-Back Configuration (2 x 330 kW)

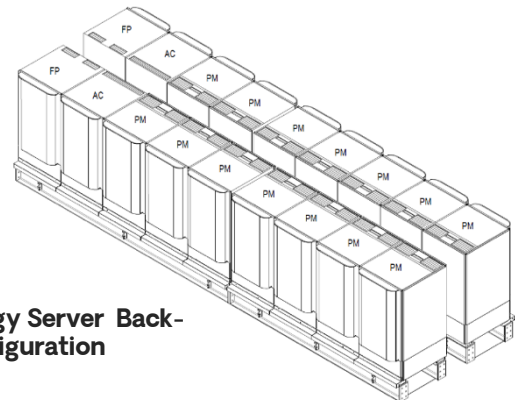


Figure 2: Packaged Energy Server base configurations

As customers evaluate their energy needs, it is important to know 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 gives some highlights of the Energy Server product, with more development underway to stay prepared and help lead the ever-changing and evolving energy market. Each deployed Energy Server is fully monitored and maintained by Bloom Energy with an available uptime of up to 99.998% and each customer is provided with a BloomConnect® customer portal to monitor system performance.

Table 1: 330 kW Energy Server – Technical Specifications

Energy Server	Technical Highlights
Electrical output ^{1,2}	330 kW, 480 V, 3-ph, 3W and 4W, 50/60 Hz
Fuel Input ³	Natural Gas, Blended Hydrogen, Biogas or Hydrogen
Average lifetime electrical efficiency ^{4,5}	54%
Heat rate (HHV)	5,811 – 7,127 Btu/kWh
Average lifetime efficiency w/ thermal ^{4,5,6}	85%
CO ₂ Emissions ⁷ @ state efficiency	679–833 lbs/MWh on natural gas; carbon neutral on directed biogas
Noise levels	<67 dBA at 10ft/~3 m
Operating temperature	-20 °C to 45 °C
Enclosure type	Outdoor
Altitude	< 2000 meters
Seismic rating	IBC Class D
Safety	FC1, UL 1741 SB, UL 1998, IEC 62477-1 ⁸ , CE, KESCO ⁸
Utility Interaction	IEEE 1547, CEI 016, KEPCO ⁸ , VDE-4110 ⁸ , G99 ⁸
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:
¹Nameplate power output for US market is often 325 kW based on the most common utility requirement of operating at a Power Factor, PF ≥0.92. If PF is <0.92, Energy Server rating is [PFx355 kW] | ² Additional voltages will be available in 2023 | ³ Additional fuel types under evaluation | ⁴Bloom's service agreement with customers includes a guarantee for efficiency and output power | ⁵ Efficiency calculations use natural gas or directed natural gas as fuel. Efficiency numbers may vary with other fuels | ⁶ Includes the additional thermal efficiency when Energy Server is combined with Combined Heat and Power Systems | ⁷ Exempt from CA Air District permitting; meets CARB 2007 emissions standards | ⁸ Indicates certificates that are expected to be available in 2023

The Energy Server Solution as Primary Power

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

Bloom Energy has created a few base Energy Server blocks that are repeatable and scalable. The most common base block for the global market is the 330 kW layout as shown in Figure 1. With a base footprint that is grouped in block sizes of 330 kW, the Energy Server is then duplicated and scaled to multiple megawatts to fit the need of any project. There is no technical limit on the size of the Energy Server for primary power applications.

Bloom offers auxiliary equipment as part of the complete power delivery solution. The auxiliary equipment are also mounted on pre-packaged and wired skid at the factory for fast installation. The auxiliary skid includes:

- **Telemetry Cabinet (TC):** For remote monitoring of the Bloom equipment
- **Water Distribution Module (WDM):** To supply water to the PMs during start-up
- **A Power Distribution Switchboard (PDS) or Energy Distribution Switchboard (EDS):** To make electrical connections to the electrical services at the site. For installations using less than three Energy Servers, the PDS and TC equipment are consolidated into a modular EDS for efficiency



The Energy Server Solution with Microgrid

When a customer wants the Energy Server to play a larger role in their energy strategy, Bloom offers a microgrid option that allows 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 financials for the customer. In the event of a grid outage, the Energy Server disconnects from the utility briefly and comes online in a grid forming mode, carrying the load pre-determined by the customer. The Energy Server will maintain this load and will resume grid parallel operation after utility power is restored.

Advanced Bloom Microgrid: The Advanced Bloom Microgrid provides uninterrupted premium quality power to keep critical loads online with no interruptions arising due to dips, spikes, noise, and outages. During a power outage, the Energy Server continues to power the critical loads and non-critical loads are shed until the power is restored. The Energy Server will maintain critical loads and resume normal operation after utility power is restored. The advanced package of the Bloom Microgrid is also capable of powering installations that may want to operate fully independent of the utility grid.

The Bloom Energy Server can be procured as a CAPEX with a maintenance agreement. Alternatively, it can be contracted as an energy service for 15-20 years through a Power Purchase Agreement (PPA) with a tolling rate or as a Managed Service agreement (MS) for 6 years with a fixed monthly payment based on the capacity of the system.

Bloom's Energy Server provides a resilient, predictable and sustainable solution that can be quickly deployed for onsite power generation.

For more information on Bloom Energy's products, please visit our website at: www.bloomenergy.com



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