

THE SPEED IMPERATIVE

THE ESSENTIAL ROLE OF
ON-DEMAND POWER IN AN
EVOLVING ENERGY LANDSCAPE





A DECADE AGO, NEARLY HALF A MILLION PEOPLE LIVING IN THE ALGERIAN PROVINCE OF ADRAR, IN THE MIDDLE OF THE SAHARA DESERT, LACKED A BASIC NECESSITY: RELIABLE ELECTRICITY. INADEQUATE POWER SUPPLY AND AGING INFRASTRUCTURE WERE CAUSING REGULAR BLACKOUTS.

Then, Adrar's residents experienced a dramatic improvement. Beginning in 2010, the Algerian national electric utility, working with Connecticut-based Mitsubishi Power Aero, formerly PW Power Systems, installed several mobile turbine packages that delivered additional on-demand power. Since then, Adrar has enjoyed reliable electricity—disruptions are few and far between. There are now 54 FT8® MOBILEPAC® packages installed across the country, totaling nearly 1.3 gigawatts. And, because of their mobile design, more than 875 megawatts of this additional capacity has already been relocated quickly and affordably to address Algeria's ever-changing needs.

Algeria is just one example of how dynamic the energy landscape has become. While the needs of specific countries and power producers vary, the common element to overcoming these challenges is speed: Today's energy sector needs equipment that is faster to install, faster to put power online, faster to relocate to meet shifting needs, and faster to maintain and repair so that power remains stable.

Consider that the global population is expected to reach nearly 10 billion by 2064 and contribute a projected 50 percent increase in energy demand over the next three decades. At the same time, the world has embraced the urgent need to decarbonize, which is driving producers in much of the world to install additional, and often intermittent, renewable sources.

Much of the new demand will come from developing regions, where governments and utilities must build enough capacity to expand electrification and support economic growth. In developed regions that are transitioning fastest to renewables, power producers must manage unpredictable supply fluctuations. And, as we've seen numerous times in recent years, weather-related events can disrupt infrastructure anywhere.

Navigating these trends—while still delivering stable, affordable electricity 24 hours a day—will require producers to implement solutions that solve today's urgent problems and also provide flexibility to address future needs.



Here are four ways producers can respond to today's speed imperative and meet the industry's mandate for on-demand power:

1

PROVIDE QUICK-START, GRID FIRING, AND DISPATCHABLE POWER FOR RENEWABLES

Global decarbonization efforts, coupled with falling costs, have given renewable energy a huge boost. According to the International Energy Agency, **renewables are set to provide more than one-third of total electricity generation globally by early 2025, overtaking coal.**

With this transition comes a significant challenge: ensuring a stable supply of electricity. When the sun doesn't shine and the wind doesn't blow, power companies may not have the ability to produce enough electricity. In the future, large-scale short and long-term energy storage technologies will provide additional capacity, but these technologies will take longer to build, posing affordability challenges. Until these technologies mature and significant capacity is deployed, having a dependable power source that can be turned on and off as needed—and quickly—is essential to reliability.

A key solution is aero-derivative gas turbines. Adapted from aircraft jet engine technology, they are designed to start and accelerate to maximum power output much faster than large-frame turbines or other conventional power plant technology. Aero-derivatives can also ramp down just as fast, allowing producers to adjust promptly to supply fluctuations, just as a pilot throttles a jet.

Since entering power generation service over 60 years ago, aero-derivative gas turbines have proven to be among the speediest to bring power online—able to start delivering power in only a couple of minutes from cold start and reaching full output in less than 10 minutes. Engineers at Mitsubishi Power have refined their turbines to reach full power in even less time if required.



RAPID START, RAMP UP AND DOWN, AND RESTART

Unlike other types of power generation, aero-derivative gas turbines are designed to transition from cold start to full power in minutes.

AS LITTLE AS
2 MIN
TO GENERATE POWER

10 MIN
OR LESS FROM COLD
START TO FULL OUTPUT



“Our customers want sustainable solutions, and our aero-derivative gas turbines and energy storage systems help enable and accelerate the transition to renewable energy,” says Harsh Shah, Mitsubishi Power Aero’s vice president of sales and business development.

Innovative solutions such as these help producers respond to the urgency and complexity of the energy transition. Fast, flexible, on-demand turbines enable them to incorporate more renewables into their generating mix, shortening the path to decarbonization for them and their customers.

“When President Kennedy set the ambitious goal of going to the moon, we didn’t get there the next day—there were many technologies that needed to be developed,” says Jim Amarel, vice president and general manager of Energy Services LLC, the in-house EPC company of Mitsubishi Power Aero. “Today, the world has a very ambitious goal for reducing CO₂, and aero-derivative gas turbines are a key technology that will help us get there faster.”

Green hydrogen will be a key alternative fuel and energy storage source for gas-powered turbines. Mitsubishi Power is leading the effort to develop green hydrogen production and long-term storage capabilities. Knowing that peaking units are prime candidates for adopting green hydrogen, Mitsubishi Power is developing hydrogen combustion capability for its FT4000® turbines. The company expects this technology to be operational in the next several years as it focuses on producing gas turbines capable of using zero-carbon fuels, thereby helping to reach 2050 zero-carbon goals.

2 ACCELERATE PROGRESS TOWARD ENERGY EQUITY

More than 770 million people worldwide still lack access to reliable electricity. Closing this gap is critical to improving standards of living and the overall economy in unelectrified regions. In fact, ensuring access to affordable, reliable, and sustainable energy for all is one of the 17 goals in the United Nation’s 2030 Agenda for Sustainable Development.

RAPID INSTALLATION

Aero-derivative packages can be delivered, installed, and operational in days for mobile units and a few months for stationary units, compared to the several years required for large, industrial gas turbine plants. Mitsubishi Power’s fastest-to-operate unit, FT8® MOBILEPAC®, can be shipped by land, air, or sea, and generate power in a matter of days.



MOBILE PACKAGES IN
DAYS

STATIONARY UNITS IN A FEW
MONTHS

Meeting this goal requires rapid electrification; infrastructure planning and investments must be flexible enough to accommodate ongoing economic and population growth as well as the shift toward renewable energy. Compounding the challenge is the fact that unelectrified regions are often in



rural areas. Resources there are limited, and investments in large, central generating stations — plus transmission and distribution systems — are too costly or difficult to plan and implement amid brisk economic change. They can also take years, which doesn't solve a community's immediate needs.

Instead, areas that lack reliable power can adopt distributed generation and get reliable power with less investment and fewer infrastructure improvements. Developing regions can build flexible microgrids, such as the ones powering Adrar and other parts of Algeria, using smaller aero-derivative units. These microgrids can respond rapidly to emerging local energy demand—and later be relocated as needs change or adapted to support the addition of renewable power sources.

Increasingly, these communities are looking for customization on a tight timeline. For example, Mitsubishi Power offers modular fixed and mobile power packages that allow customers to combine as many units as needed to meet local demand. The company can tailor the installation to the most challenging sites, prefabricating part of the package to streamline installation. A local power producer can have a facility designed, built, and generating power in only a few months, compared to the several years typically needed for a combined-cycle plant. Those same units can also serve as reserve power in areas where local power companies are adding renewable power to their grids.

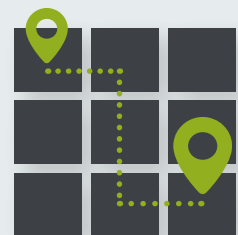
"Less-developed countries have the same goals for reliable power, but they're at different places along the sustainability road than developed nations that already have strong infrastructure and a mix of generating technologies," says Mitsubishi Power Aero CEO Raul Pereda. "Smaller, fast-track units are essential to help them meet growing demand."

3 MOVE POWER RESOURCES TO WHERE THEY'RE NEEDED

With increasing dependence on electricity, the impact of shortages or full-scale blackouts is becoming greater. Not only are homes left temporarily without power, but also factories sit idle, public transportation systems stop functioning, and hospitals are unable to deliver critical care. In areas with increasing numbers of electric vehicles, those depleted EVs are inoperable. In some regions, these gaps are predictable, such as seasonal blackouts or brownouts when demand for heat or air conditioning overwhelms local supply. In fact, any location could find itself unexpectedly unable to meet energy demand if a weather event or a natural disaster disrupts the grid.

RAPID MOBILITY

With Mitsubishi Power mobile units, customers can relocate 30-megawatt blocks of power quickly and affordably where it's needed most to address critical power requirements or in response to emergencies. Under the most demanding O&G applications, where units were relocated every few weeks, the entire process – shutdown to relocation to restart – took as little as 48 hours.



**SHUTDOWN TO
RELOCATION TO RESTART
IN AS LITTLE AS**

48 HRS



Power producers need flexible on-demand solutions to maintain reliability in even the most extreme circumstances. Aero-derivative turbines—already proven as reliable peaking units—can provide even more flexibility when built on mobile platforms.

For example, there are many areas where existing power generation assets are not able to handle significant increases in demand due to extreme heat or cold. Utilities in these regions often depend on importing megawatts from neighboring regions or countries to fill the gaps. This strategy is reasonable, but can be risky when surplus power is no longer available to share. When that happens, residential, industrial, and agricultural customers are required to reduce consumption or shut down completely.

Power producers facing this situation will sometimes rely on expensive rental power during the warmer or colder months; but boosting local generating capacity with mobile turbine packages can be a more permanent and affordable solution. Because of the quick-install design, numerous pre-commissioned systems, and a highly-qualified project execution team, Mitsubishi Power Aero turbines can provide power in just a few months from the date of the order — in time to meet peak power demand.

In emergencies, time is of the essence. In places like Puerto Rico, which saw its electric grid devastated by Hurricane Maria in 2017, mobile aero-derivative turbines are a potentially life-saving option. During the rebuilding efforts, Mitsubishi Power provided three MOBILEPAC® units at the Palo Seco Power Plant. The units delivered vital power following the earthquakes that struck in late 2019 and early

2020. And because these units can be moved elsewhere on the island in a matter of days, they offer a flexible way to manage future emergencies.

In Mexicali, Mexico, Mitsubishi Power Aero supplied a fast-track, dual-fuel installation that took just 110 days from contract to commercial operation and provides emergency power continuously during the four months of summer peak. These eight MOBILEPAC® gas turbines operate in the hottest months of the year to provide up to 240 MW of power when it is needed the most.

4

OPTIMIZE THE AVAILABILITY OF POWER EQUIPMENT

All turbines will eventually require routine maintenance and occasional repairs during their decades-long life span. Minimizing unnecessary downtime is essential to reducing the cost of ownership and ensuring the availability of power.

Because of their aircraft engine heritage, aero-derivative turbines are already a proven and highly reliable technology. They allow power producers to adopt a maintenance philosophy similar to that in aviation, where engine swaps are used to keep planes in the air. When engine maintenance is scheduled or needed, an aero-derivative unit can be taken offline just long enough to change out the engine and promptly return the unit to service, keeping the electricity flowing.

To reduce downtime, Mitsubishi Power takes its cue from military “tiger teams” and makes sure the right mix of specialized, cross-functional team members are engaged to diagnose and resolve customer issues quickly. This service



CUSTOMER SUPPORT 24/7

To maximize the availability and performance of power packages operating around the globe, Mitsubishi Power customer service managers are deployed worldwide to customers' time zones and geographies. Increasingly, the use of remote monitoring technology for a real-time view of customer equipment data expedites troubleshooting, alleviates downtime costs, and improves overall reliability.



CUSTOMER SUPPORT
AVAILABLE

24/7

approach is enhanced with the use of advanced remote monitoring and diagnostics technology installed at customer sites. These systems provide instant data to both customer and Mitsubishi Power engineers, allowing them to diagnose problems without delay and even anticipate issues before they arise, as they're doing for gas-pumping stations in Europe, and similarly for more traditional power generation stations in the U.S.

When an issue occurs, facility operators may not have time to examine detailed data. Rather than adding work for the on-site team, Mitsubishi Power engineers turn to remote monitoring and diagnostic reporting systems for real-time access to plant control and monitoring systems. They find the data they need to troubleshoot, often in a matter of

minutes or hours. "Customers expect a faster response," says Raul Romero, Mitsubishi Power Aero's vice president of aftermarket services. "With the monitoring and diagnostics systems, they have a degree of comfort knowing that we're connected to them directly and are able to assist with a quick diagnosis."

ACCELERATING ENERGY'S TRANSFORMATION

The demographic, economic, and political forces reshaping the energy landscape are making power systems increasingly complex. Infrastructure must adapt to accommodate a range of technologies, including conventional coal, large-frame gas turbine systems, aero-derivative gas turbines, renewable generation, and energy storage, as well as newly developing applications for green hydrogen.

Regardless of how power producers configure their portfolios, they face the same pressure to provide stable, affordable electricity. To strike that balance, they should identify areas where they need to expand capacity rapidly, secure their grids with reliable dispatchable power, enhance the mobility of their assets, and maximize their availability. This proactive approach will help them meet the industry's power mandate today and tomorrow—with the utmost speed.

"While having unlimited, reliable, and affordable electricity available 24/7 is the expectation, in many places around the world it's not the norm. We must strive for that same standard globally," says Pereda. "There's no reason we can't get there, and get there fast, because we have the technology to deliver on-demand power anywhere in the world."

