Capitalizing on More Capacity and Energy for Gas Power Plants

Using Digital for Capacity Optimization to Increase Returns
Market Dynamics Impact
Gas Plant Operations

Power producers and utilities today face many challenges as they look to increase energy revenues, meet output commitments, manage capital expenditures, and reduce operating margins. This drive for plant returns requires managing operating profiles and configurations to provide more power to the grid during periods of high demand in an increasingly volatile environment without taking on more risk. For gas plants competing in an open energy market, it is important to capture revenue when energy prices are high, avoid penalties from missed targets, minimize the impact of any operational changes on outage intervals or take advantage of new opportunities in ancillary markets. For plants servicing vertically integrated utilities or regulated territories, it is important to improve the power plant’s dispatch position, achieve margins with lower capital expense, and increase reserve capacity or emergency response on the system. Often gas power plants that supply either baseload power or grid support face stiff penalties when targets are unmet. When the power plant’s cycles within the day to support shifting demand or to balance renewables, there is more need for extended capacity to supply energy during periods of peak demand. (Fig.1) In the face of normal degradation, hot day lapses that reduce potential output, or simply to reduce risk, plant managers and operators will backstop their full capacity forecast by hedging to ensure the plant does not miss its targets.

Therefore, identifying the right tools to exploit the power plant’s full capability at the right time and capitalize on higher energy prices is critical.

Leveraging gas power plant capacity requires:

- Understanding the economic return and calculating the best operational setpoints for generation assets such as the gas turbine and plant equipment.
- Understanding true plant capacity including extended output in the near-term with confidence and accuracy.
- Achieving maximum power output while managing operational boundaries and accounting for plant asset life impact.
- Orchestrating execution across the entire power plant in real time to achieve better results.
- Adjusting for ambient conditions and various technical/regulatory constraints such as grid codes and emissions.
Juggling these considerations is a major challenge for plant operations staff and often leaves “money on the table.” At the same time, energy traders need accurate day ahead and real-time plant performance data to submit better bids and make more profitable commitments. Fleet dispatchers need the same insights to create the optimal dispatch stack. Many traders and dispatchers receive conservative plant capacity forecasts and lack the tools needed to derive the best dispatch schedule for the portfolio or capitalize on market spikes and optimal bidding windows throughout the day. Some markets require power generators to reserve a portion of their capacity for grid stability and others pay a premium for additional capacity on ancillary markets. As more markets deregulate and consider modifications to dispatch and trading of real-time reserve capacity, there will be more opportunity to capture revenue such as proposed changes in the Electric Reliability Council of Texas (ERCOT) that improves pricing for local reserve capacity over more expensive out-of-market reserves.

Digital solutions help plant managers and operators to:

- Leverage new plant equipment operating modes including gas turbine cold part load to bank energy during off-peak demand periods.
- Use banked MW-hours to extend capacity during on-peak demand periods when spark spreads are high without impacting outage plans.
- Forecast day-ahead and real-time plant capacity with optional bid support for traders to increase revenue and better commitments for dispatchers solving for more economic dispatch schedules.
- Reduce the effects of hot day lapse in base capacity using extended operating modes to increase capacity.
- Improve degradation response over time.
- Improve capacity forecasts, reduce bid backstopping or output hedging.
- Determine economic dispatch of duct burners by modulating duct burner fuel flow or shedding gas turbine load for duct burner power for ancillary response.
- Dynamically modeling near-term plant capacity demand and duration of duct burner startup to determine optimal duct burner turn on/off timing to safe fuel and improve margins.
- Use automation and optimization to prevent over-shooting or under-shooting duct burner use for most efficient operation.

Emerging digital solutions can provide power generators with the necessary tools to reduce risk and capitalize on the full potential of their gas power plant. Digital optimization tools offering a clear line of sight into true plant capabilities, factoring for changing ambient conditions and asset degradation, can be the difference between making a profit or leaving money on the table. The gas power plant can enjoy more capacity leading to ongoing revenue from Energy markets, additional output in ancillary or capacity markets or reduced risk associated with an aggressive energy bid. The added capacity can also level output to offset degradation over time or performance shortfalls due to hot weather conditions.

Figure 2. Forecast capacity in granular detail for better dispatch and energy trading
Emerging digital solutions can provide power producers with the necessary tools to increase competitiveness. Leveraging sophisticated analytics, plant managers, operators, dispatchers and traders can connect, analyze, and enhance how their generation assets work by orchestrating operations to achieve more productivity.

Technology advances in big data, analytics, and automation along with machine learning and artificial intelligence help the forward-thinking plant operator to increase capacity, improve decision support, and optimize operations. Using GE’s Digital Twin and Operations Performance Management (OPM), plant managers, dispatchers and traders gain essential new insights to take advantage of the full power of digital solutions to future proof the plant and to see production planning and operations with fresh eyes. Adopting a digital maturity, the gas power plant can capitalize on capacity to improve margins, reduce expenses, and capture revenues.

**Digital Solutions Offer Capacity Optimization**

**OPERATIONS PERFORMANCE MANAGEMENT (OPM) OFFERS:**
- Capacity dispatch optimization with supervisory edge application.
- Automated control of gas turbine and plant operating parameters.
- Monitoring performance and gas turbine life.
- Advisory of economic dispatch options.
- Integration edge-to-cloud from Industrial Internet Control System platform to plant DCS, unit controllers, and other monitoring platforms.

**Plan**
- Production Planning
- Commitment Planning
- Fuel Nomination
- Dispatch Planning

**Optimize**
- Base capacity
- Extended Output
- Reserve Capacity
- Capacity Leveling

**Orchestrate**
- Visibility into plant operations
- Economic value of plant output and plant responsiveness
- Actionable decision support and advice aligned to strategic goals
Plan

Many gas power plants are still blazing the trails of their digital journeys. Enabling strategic planning through digital monitoring and diagnostics, Operations Performance Management (OPM) supports production and dispatch planning, commitment preparation, and maintenance planning. Plant managers and operators, dispatch planners, traders, and central operations personnel can each leverage the OPM digital solution to drive capacity optimizations netting better margins.

Production Planning

OPM provides better insight into true plant capacity. By understanding how to deliver the best outcomes with the ability to benchmark and score plant performance, monitor and diagnose issues impacting megawatt (MW) output (at a plant, unit, and block level), and forecast output and heat rate adjusted for ambient conditions, plant managers, dispatchers and traders get solution-supported operational intelligence to drive quality decision making regarding output levels and economic dispatch.

Dispatch Planning

Digital modeling, artificial intelligence, and machine learning efficiently improve dispatch planning. For plants that do not competitively bid megawatts (MWs), the solution advises on the most economical way for plant assets to generate the power including whether to peak fire the gas turbine and or use duct burners to reach load targets. Based on the forecasted operating envelope, digital analysis combines plant assets such as gas turbines, inlet conditioning, supplementary firing, and more to determine the best way to achieve a particulate MW commitment including offsets for degradation over time or hot day lapse.

Commitment Preparation

Reflecting plant and site performance with weather and supplementary power forecasting, digital solutions calculates better bidding strategies. With day ahead and real-time insight about each unit’s minimum and maximum capacity and heat rate at various load points, traders can make the most of energy markets including real-time capacity, and ancillary reserves. These tools also drive efficient determination of the most economical option in both regulated and competitive markets.

Benefitting from added visibility from a digital solution, traders are also positioned to exploit the energy bank during peak spark spread conditions (Fig. 2). With Digital Twin-powered analysis, a volatile market can become more predictable, which enables more accurate bids and commitments.

Maintenance Planning

By considering the maintenance impact on the gas turbine, the digital solution tracks operating hours at colder temperatures during part load in an energy bank which can offset operating hours at higher temperatures for extended load and keep maintenance planning in balance based on operational wear and tear. With a robust gas turbine lifing models, the solution can continually adjust firing temperatures to add or subtract from a bank of MW hours across the maintenance interval, so that the megawatt hour (MWh) balance can inform operators, traders and dispatchers of the most economic outcome that results in higher profits across the interval.

Figure 3. Viewing the MWh bank to balance economic value with outage schedules.
Modify Part Load Operations
By operating the gas turbine at less stressful temperatures below traditional part load conditions during periods when energy demand and pricing is low, an energy bank accrues a megawatt hour (MWH) balance. OPM keeps plant staff, traders and dispatchers informed of the accrued hours to offset the impact of peak operating hours. While this operating mode has less efficient fuel consumption, those operating costs are more than recovered with more dispatch hours and higher energy prices.

Enhance Base Load Operations
With better forecasting models and analytics, OPM informs plant operations and traders of base load and max load capacity to effectively eliminate the need for hedging or holding MWs in reserve to avoid missing targets. The Digital solution uses a Digital Twin of the gas power plant, advanced analytics, optimization with artificial intelligence, and machine learning and automation to continuously solve for the best setting to achieve output commitments. This includes emissions related operational constraints.

Extend Output Performance
OPM enables new operating modes to boost MW output up to ~4% over baseload while foregoing the impact of traditional maintenance date and operating costs. The result is a higher “digital nameplate” that can be monetize through higher ancillary payments for reserve capacity or by selling MWS on real-time exchanges when energy prices spike to meet underserved demand.

Recover Capacity
To maintain output commitments in the face of normal degradation or due to a lapse in output on a hot day, the Digital solution can automatically adjust gas turbine temperatures for peak load or time the utilization of duct burners to avoid missed targets. With the ability to level capacity, plant managers will not need to hold capacity in reserve and traders and dispatchers can utilize MW forecasts with more confidence for optimal dispatch.
Operations Performance Management provides plant-wide system orchestration to manage capacity commitments and risk by adhering to maintenance intervals. Although the dollar values of these optimizations improvements will vary by region, OPM’s potential impact can be seen in the improvements the digital solution orchestrates. These include:

- Greater visibility into plant operations.
- Enhanced strategic planning insights.
- Improved monitoring and diagnostics.
- More revenue opportunities.
- Reduced operational risk.
- Expanded load ranges.
- Actionable decision support and advice.

By optimizing improving efficiency, flexibility, capacity, and emissions, Operations Performance Management identifies opportunities to capture more revenue by reducing hedging, lowering the need for reserve capacity due to degradation, and expanding operating modes to higher output ranges.
The Digital solution provides asset managers the needed tools to better perform maintenance outage interval planning and monitoring throughout the long-term interval mission. Plant managers and staff gain greater insight, decision support, and control capabilities to maximize energy production opportunities.

Also, with Digital Twin and OPM providing added transparency between commercial and power plant staff, operational expenses can be streamlined as productivity increases throughout the operation. More powerful monitoring tools, too, can ensure asset health while reducing downtime and risk (Fig. 3).

Figure 4. Dashboard with real-time maintenance factors and energy bank visibility.

Capture revenue

Revenue generation relies on power producers, traders, and asset managers making smart decisions regarding when to bank energy (MWH balance). The OPM solution recommends the best economic balance between part load and peak load operation across the maintenance interval. With the insights needed to maintain output commitments in the face of degradation or hot days, the plant can raise capacity and increase extended output within emissions limits, while positioning itself to capture more revenue between intervals.

Drawing on real-time optimization insights, plant decision-makers can also better identify when to increase peak production to drive energy share and grow revenue streams. Providing detailed reporting and optimized control of recovery, base load, peak load, and outage, OPM enables revenue capture opportunities from price spikes, reduces hedging, and expands capacity payment revenues.

Capacity Optimization Outcomes

- **Output bump for base load**
- **Cold day performance**
- **Reserve margin control**
- **More accurate day-ahead forecast**

- **Extend output and energy periodically**
- **Bank MW hours to limit maintenance impact**
- **Adapt output on cold days**

- **Offset degradation**
- **Compensate for hot day lapses**
- **Avoid bid backstopping**

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Capitalizing on More Output for Gas Power Plants
Gas power plants today must embrace digital transformation to remain competitive. A digital solution such as GE’s Operations Performance Management, drawing on more than a decade of experience in model-based control, artificial intelligence, and machine learning with installations globally, delivers the next advancement in analytics and automation.

To truly capitalize on capacity, improve dispatch position, expand operating modes, reduce the impact of operations on maintenance, and achieve emission objectives more effectively, digital transformation is the essential next step. Try these best practices:

• Baseline performance today and include detailed understanding of regulatory requirements for emissions compliance at all load levels.
• Evaluate any changes in near- to long-term operations, such as new competitors, new energy markets such as real-time capacity and ancillary services or an increase in renewables, to gauge future impacts on plant performance.
• Assess digital maturity and operational readiness.
• Determine potential gains of adopting a digital approach to increase capacity.
• Engage experts to map the best path to increase revenue opportunities.

GE Power can help gauge plant readiness for digital solutions. Our seasoned team members can conduct assessments to identify productivity challenges, map out improvements, and offer granular insights into the full potential value of digital transformation. Boost productivity and increase plant responsiveness to better meet fast-changing grid demands implementing an advanced digital software solution.