WORLDWIDE GAS TURBINE FORECAST

TMI Staff & Contributors

DECLINES ARE APPARENT FOR THE NEXT FEW YEARS, BUT A MARKET RECOVERY IS IN SIGHT

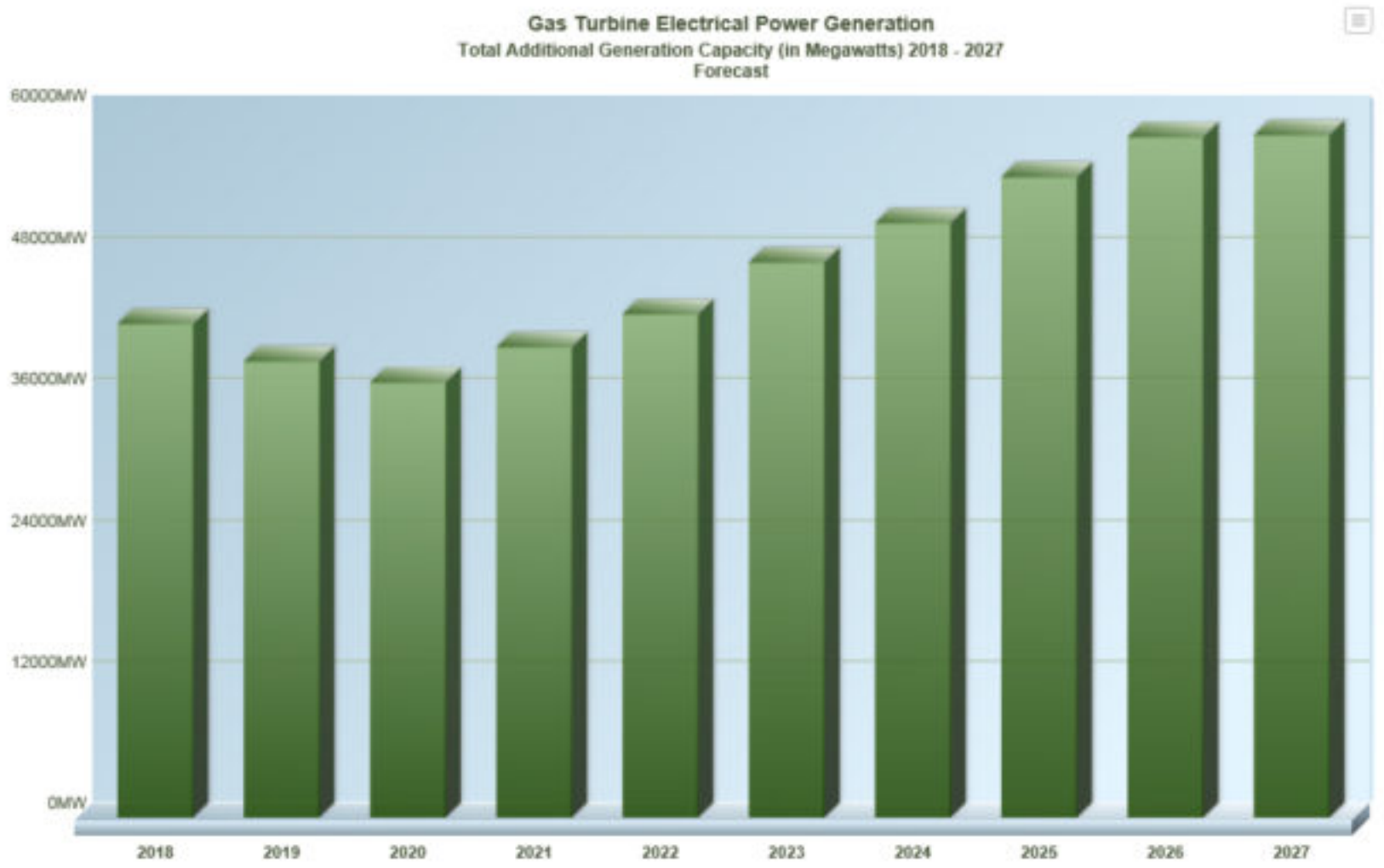
By Stuart Slade and Carter Palmer, Forecast International

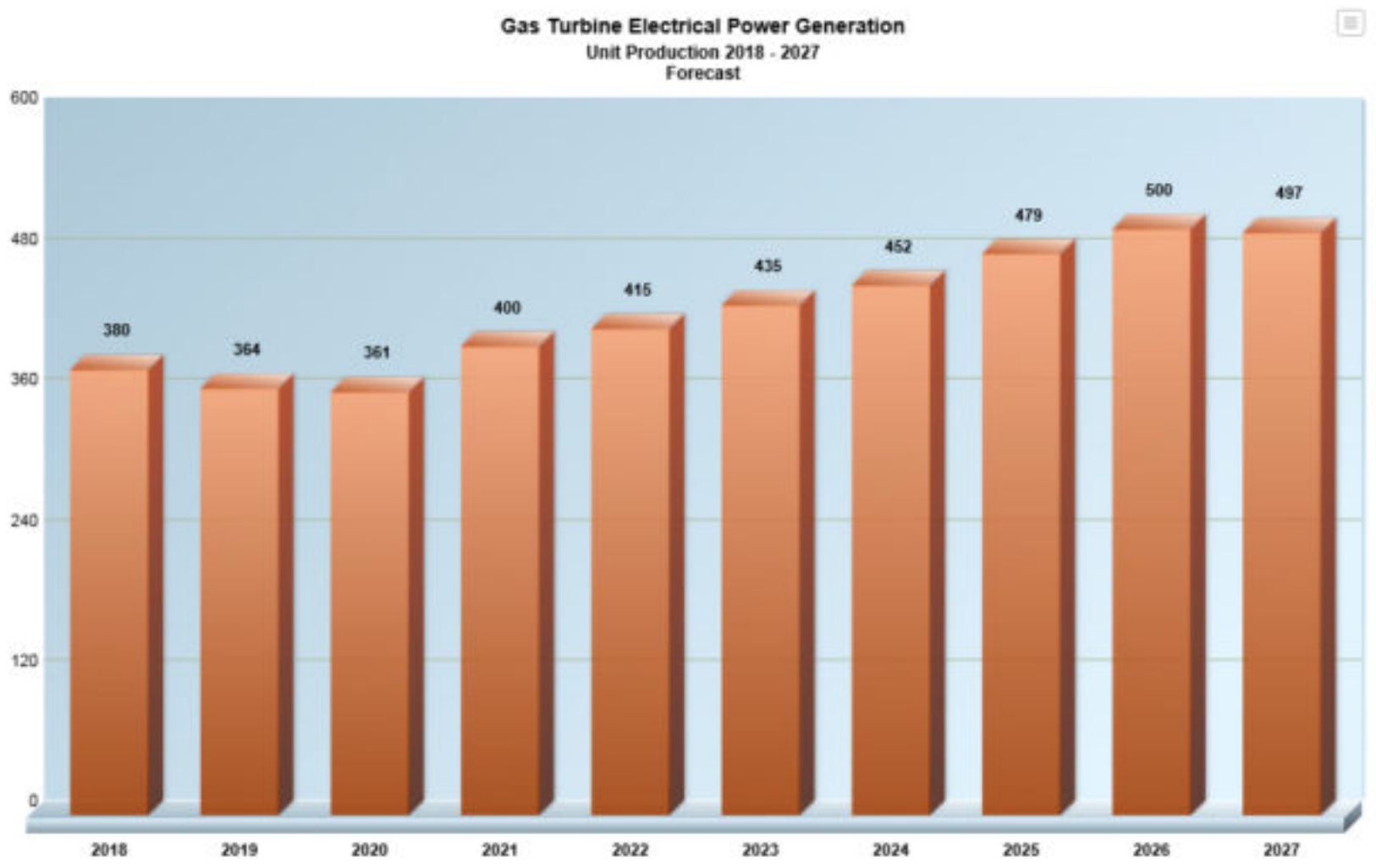
Overcapacity of power generation equipment and the resulting softness of prices is impacting the gas turbine-powered electrical generation market. In short, companies are selling significantly fewer gas turbines than predicted and are receiving a lower unit price on each sale.

The direness of the situation is exemplified in a recent statement from Siemens AG about the restructuring of its power generation activities to accommodate the world situation:

"Global demand for large gas turbines (generating more than 100 megawatts) has fallen drastically and is expected to level out at around 110 turbines a year. By contrast, the technical manufacturing capacity of all producers worldwide is estimated at around 400 turbines."

These figures confirm independent estimates by Forecast International that showed power generation gas turbine sales over the period 2018–2027 will total $107.433 billion, a decrease of 7.35% over sales during the 2017–2026 period. This equates to a significant reduction in income and greater pressure on profit margins.





As a result, all three of the leading companies in the power generation equipment sector, GE, Siemens and MHPS, have undertaken major restructuring initiatives to reduce costs and rationalize production.

For the near term, there appears to be little relief in sight from the current

market depression. Indeed, as projections have been refined, the market recession has grown deeper and is extending further into the future.

In 2018, Forecast International undertook a modernization of its industrial and marine databases. Power brackets have been refined to accommodate steady increases in gas turbine output and calculations of added power production capacity supplementing the existing unit and value forecasts. These changes turned out to be revealing (Figure 1).

Based on this information, it appears certain that the current situation of reduced demand, overcapacity, and soft prices is set to continue until at least the early 2020s. It will probably be 2022 before annual increases in installed capacity equal those of 2018, which represented a substantial reduction over previous years. However, the recovery of installed capacity from this low point is quite marked and increases rapidly until around 2026.

The primary driver for this recovery is the development of large combined cycle facilities in industrialized nations, notably Japan, Europe and Asia. The replacement of highly polluting plants will be a significant factor during this period.

It will be supplemented by the modernization of older facilities to meet efficiency standards. Gas turbines built in the 1960s and early 1970s are going to be replaced with modern turbines. The significance of this trend in added capacity can be illustrated by comparing Figure 1 to Figure 2 on unit sales.

Comparing these charts, it can be seen that the average output of a power generation gas turbine in 2018 is 110 MW. By 2027, this increases to 116.5 MW. A close examination of the data shows that this trend is accelerating. Note that this figure does not take into the account the major increase in output and efficiency resulting from the widespread introduction of larger-scale combined cycle plants.

The recovery of waste heat from gas turbines and its use to drive a steam

turbine has resulted in efficiencies in excess of 60% for plants with outputs in the 800 MW to 1,000 MW range.

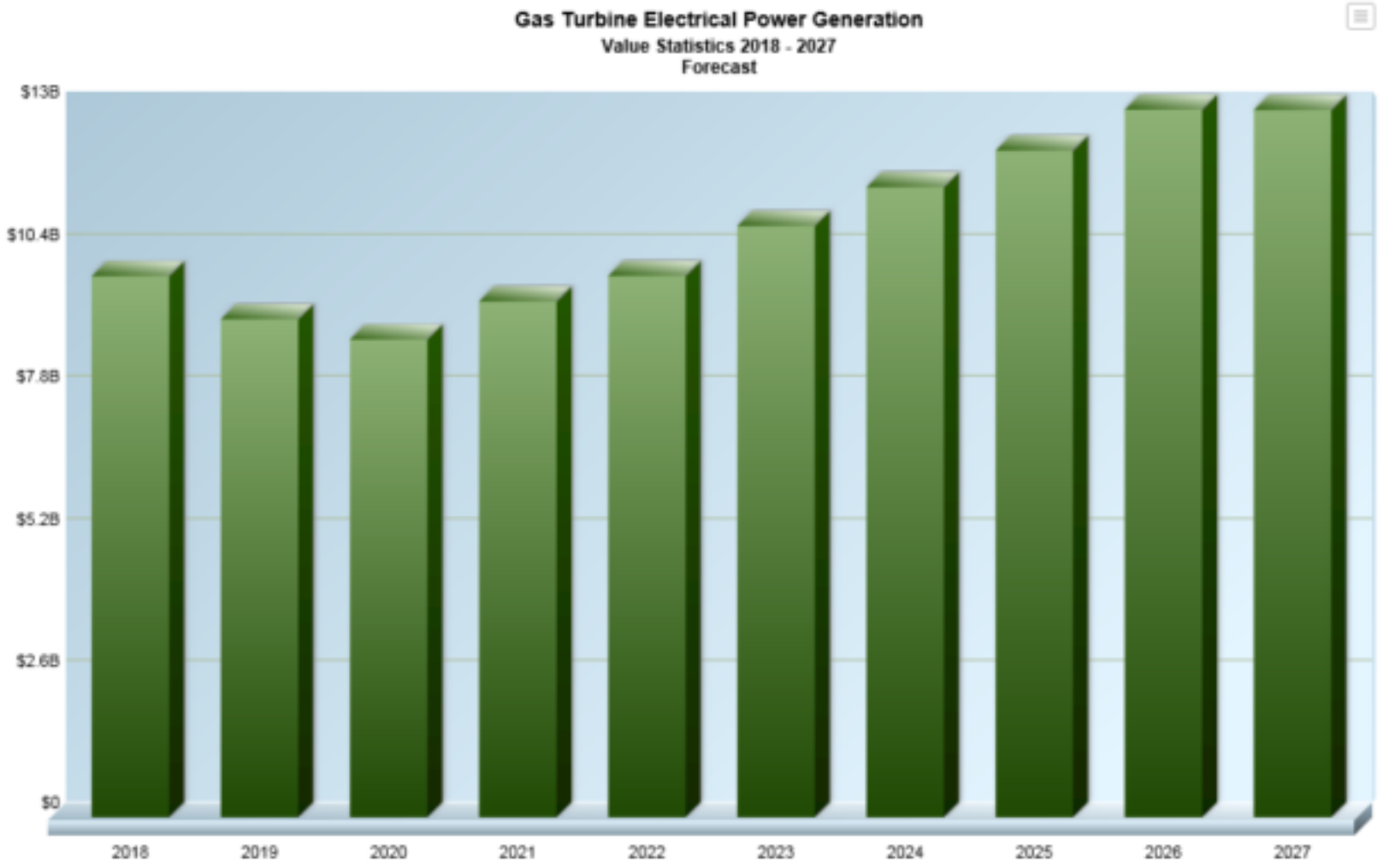
This highlights another profound change in the financial picture. Gas turbine procurement is no longer directly related to increasing power demands. Instead, the option of procuring additional gas turbines is but one of many that are available to both generation and distribution companies.

Another way of looking at this is to compare the costs of generating a megawatt of power in 2018 with those likely to be applicable in 2027. In 2018, it cost a total of $4.2 million to add a megawatt of generating capacity. By 2027, this figure will rise to $4.4 million. There is, of course, considerable regional variation.

Comparing the projected graphs for the 2018–2027 period in terms of total power output, number of units and value (Figures 1, 2, and 3), shows that the two most closely aligned are value of production and total power output. The post-recession increases are significantly lower when expressed in units than they are when displayed in value and power output.

This suggests that the largest turbines represent the major area of industry growth, those in the 250–500 MW and 500–750 MW brackets. At the same time, we are also seeing significant growth in the microturbine area.

Putting these factors together suggests that the smaller gas turbine power output class in the 20–100 MW brackets is being squeezed. This is also area the area where aeroderivative turbines are making their greatest impact. This does not bode well for established non-aeroderivative products in this bracket.



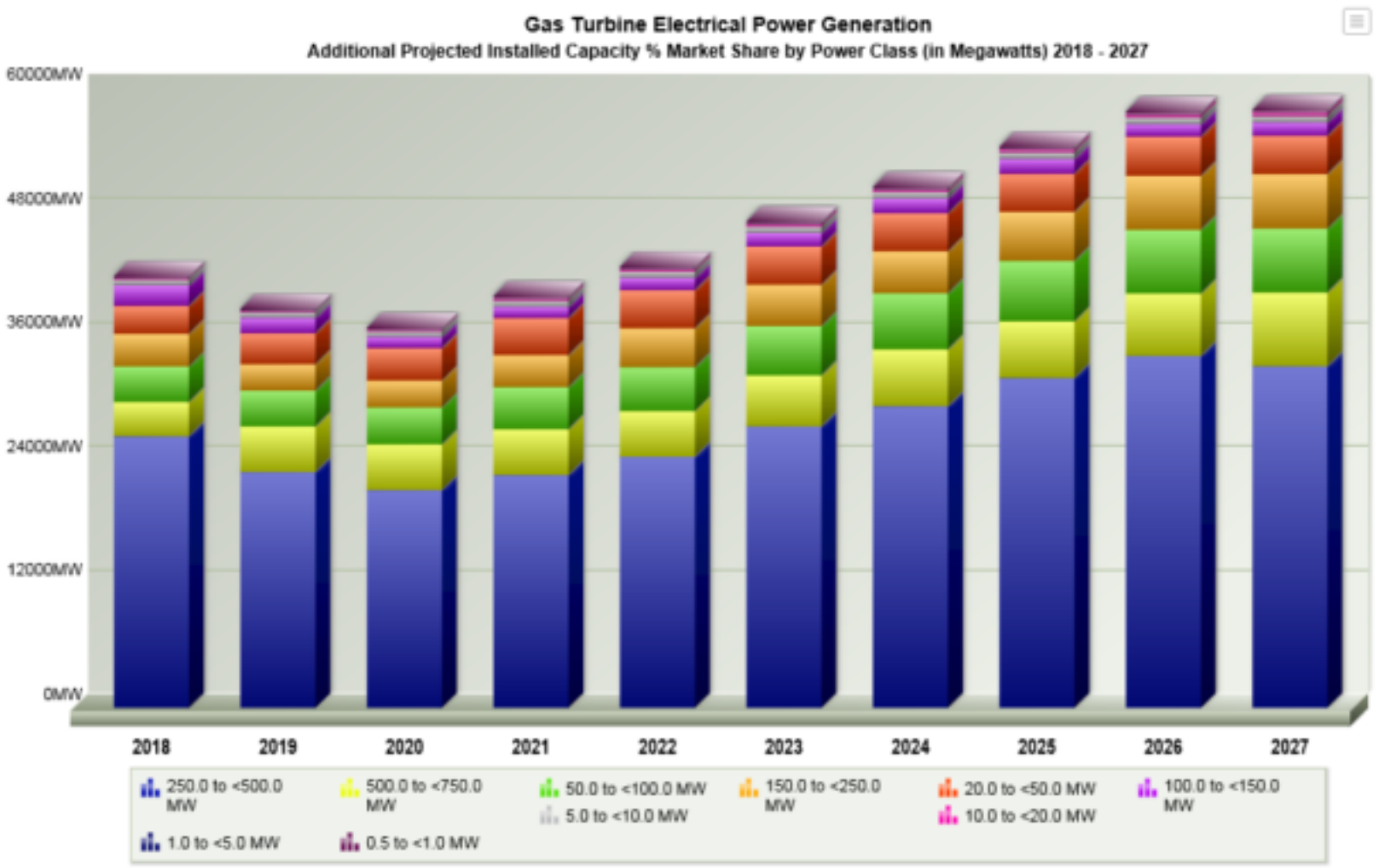


Figure 4 highlights total installed power output for the 2018–2027 period by power class. It is apparent that the 250–500 MW class is the backbone of the power generation industry and looks set to hold this position for at least the next decade.

This category has been a less badly hit by the current recession than most other sectors. The 500–750 MW segment is also gaining steadily in importance as is the 50–150 MW segment. The latter sector appears to be largely due to aeroderivative gas turbines.

Small turbines and microturbines make a tiny contribution to overall power capacity. But they account for the majority of unit sales. The modularity and flexibility of smaller turbines as well as low emissions levels are some of the advantages promoting their adoption.

Small turbines and microturbines

The outlook is largely positive for small gas turbines in the 1 MW to 10 MW range. Market analysis reveals a slight decrease in value and unit production over the near-term with overall positive growth out to 2027. Gas turbines in this power class, though, face stiff competition. Reciprocating engines are gaining ground due to relatively high efficiency in this power range.

Mircroturbines have a slightly different outlook. Power generation capacity is predicted to level off in the forecast period. There was a significant increase in the market in 2018 due to a huge Russian order for FlexEnergy turbines.

Unit production, though, may be in for a shake-up. Two new European companies are coming to market with unconventional products. Micro Turbine Technologies and Bladon Jets have both developed small machines. MTT's EnerTwin produces 3.2 kW and is optimized for heat production in smaller buildings.

Bladon Jets' MTG12 is 12 kW and geared for powering remote mobile phone towers. These new microturbines are just hitting the market. Their overall share will be minor in terms of power production and value. But both are likely to have a significant impact on unit totals. While Capstone Turbine will remain the top unit producer, Bladon and MTT are predicted to occupy second and third place over the forecast period.

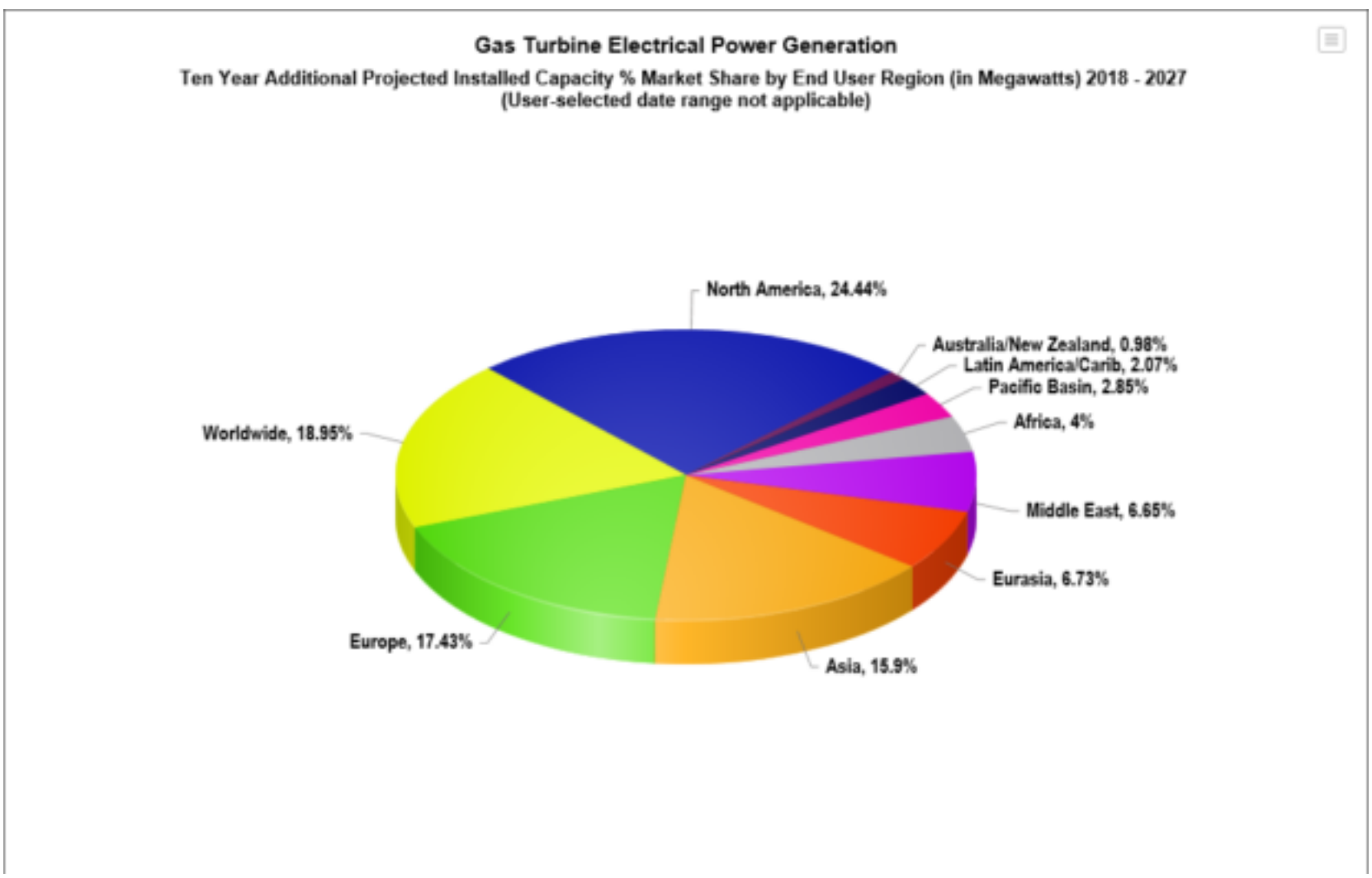
Regional trends

Changing user consumption profiles has become a worldwide phenomenon, although the motivation may differ from region to region. In Europe and the U.S., the primary driver is to reduce electricity demand and thus reduce pollution and eliminate potentially harmful emissions.

In other areas, the economic benefits of new, power-efficient technologies are the leading driver, placing electrical equipment within the reach of people who otherwise could not afford to run it.

Some factors, though, are common on a worldwide basis. Natural gas has become the go-to fuel for power generation, feeding at least 75% of gas turbines used for generation duty. Yet even here, there are exceptions. Coal- and oil-powered plants are still ordered in the Asia-Pacific region, while coal is preferred in Eastern Europe.

The forecast for the next ten years has North America continuing as the largest market in terms of added capacity and value of gas turbines, with Europe second. Both markets, however, can be considered mature. There is plenty of unrealized potential for gas turbine additions in other regions.



United States of America

According to the U.S. Energy Information Administration, coal currently accounts for about 41% of the nation's power versus 27% from natural gas. This situation is changing fast. By 2035, the agency anticipates natural gas will be the primary fuel for power generation.

Natural gas-fired generation is projected to grow 3.1% a year through 2038, meaning that more than 340,000 MW of gas-fired capacity will be added to the U.S. grid in that time frame.

The primary factors driving the shift to gas-powered generation are the favorable economics of building gas plants, confidence in the long-term fuel supply, and environmental regulations that are making the continued use of coal-fired generation more arduous.

However, there has been a push by the current administration to roll back the phase-out of coal and to find ways of enabling its use in environmentally responsible power plants.

The impact of improved distribution and grid control in the U.S. is continuing to blur the distinction between baseload capacity and the rest. Now, only nuclear-powered generation capacity is unequivocally considered to be baseload due to its long run times at steady-state load. In this climate, sales of G-, H- and J-class machines are increasing as utilities place more importance on efficiency.

Western Europe

According to Eurostat, the primary source of energy data on countries within the European Union, total net electricity generation in the EU was 2.78 million gigawatt hours (GWh) in 2016. This represented an increase of 1.1% from the year before, reversing a long-standing fall in output dating back to 2011. In aggregate, however, the level of net electricity generation in 2016 was still 14% lower than its peak level of 3.22 million GWh in 2008.

Germany had the highest level of net electricity generation in 2014 among the EU member states, accounting for 18.6% of the EU total, just ahead of France at 15.8%. The United Kingdom was the only other member state with a double-digit share, at 10.9%.

The drive to reduce emissions, conserve resources, and increase energy efficiency has affected European generation by bringing about the elimination of older plants and slashing the use of coal. In Britain, this has resulted in the virtual elimination of coal as a power generation fuel.

A declining energy market does not appear to be good news for turbine suppliers, but the situation is not completely negative. Older, less efficient plants are being replaced by new technology. Gas is replacing coal, and cogeneration is becoming more commonplace. Thus, Western Europe will continue to be a marketplace for power generation turbines, although major growth will be found elsewhere.

Eastern Europe

The fall in electricity generation over the period 2010–2014 may have been reproduced across Western Europe. But net electricity generation rose in Eastern Europe, including Romania, Poland, Slovenia, Bulgaria and the Czech Republic.

The primary driver here has been the long, slow recovery of these countries from the decades of stagnation under communism. They have emerged with legacy power generation systems comprised of old, inefficient, and poorly maintained equipment.

At the moment, natural gas only accounts for 9% of generation capacity in this region. Doubts over the stability of supplies from Russia count against further expansion of gas-fired capacity.

Gas turbines, though, retain a strong position in Poland, Croatia, Macedonia and Hungary. Poland has plans to build up to 8,000 MW of gas-fired generating capacity over the next decade.

Overall, market opportunities in Eastern Europe are good. Constraining factors are economic rather than technical or environmental. This suggests that companies selling successfully to this market sector will do so by aiding customers in finding financing.

Southeast Asia

Southeast Asia's energy demand is projected to grow by 80% by 2040 as the regional economy triples in size and the population rises by almost a quarter to 760 million. Oil demand is predicted to rise from 4.7 million barrels per day in 2014 to 6.8 million b/d in 2040, and natural gas use will grow by almost two-thirds to around 265 billion cubic meters.

In sharp contrast to the regions above, coal demand will expand at an unprecedented rate. By the end of the projection period, coal will overtake oil to become the largest fuel in the energy mix.

Meeting Southeast Asia's hunger for electrical power will require the installation of 400 GW of power generation capacity, of which 40% will be coal fired. The rise in coal use is underpinned by economic factors, abundant supplies, and the need for rapid electrification.

But it also highlights the need to accelerate the deployment of more efficient technologies to address the rise in local pollution and CO_2 emissions. There remains significant potential for deploying more efficient coal-fired power plants.

The average efficiency of Southeast Asia's coal-fired power plants has increased by about 5% in recent years, but more than 50% of total coal-fired installed capacity in the region is still below world standard efficiency levels.

Another aspect of the energy situation in Southeast Asia is limited power generation grids and regional interconnectivity. In some areas, they are almost non-existent. These conditions run against investment in power generation since a glut of power in one area cannot easily be transferred to cover deficits in another.

This, more than a lack of total generating capacity, explains the prevalence of brownouts and gasouts in many parts of the region. Major increases in power generation capacity and enhanced grid interconnections could stimulate economic development by providing more efficient, reliable and resilient electricity service across the region.

Therefore, investment in these sectors is a high priority, and a stable and lucrative market for both gas and steam turbine producers appears to be inevitable.

India and China

India and China, the two most populous countries in the world by a wide margin, share many of the same power generation issues as Southeast Asia. The sheer size of their populations presents grave problems for those seeking to spread economic development.

Both are short of electrical power. The generation capacity is inefficient and a major cause of pollution. Power distribution grids are incomplete and lack proper coordination and administration.

Under Prime Minister Modi, India has eliminated much of the centralized bureaucracy that hampered previous energy generation investment. But the country remains wedded to the concept of set development plans.

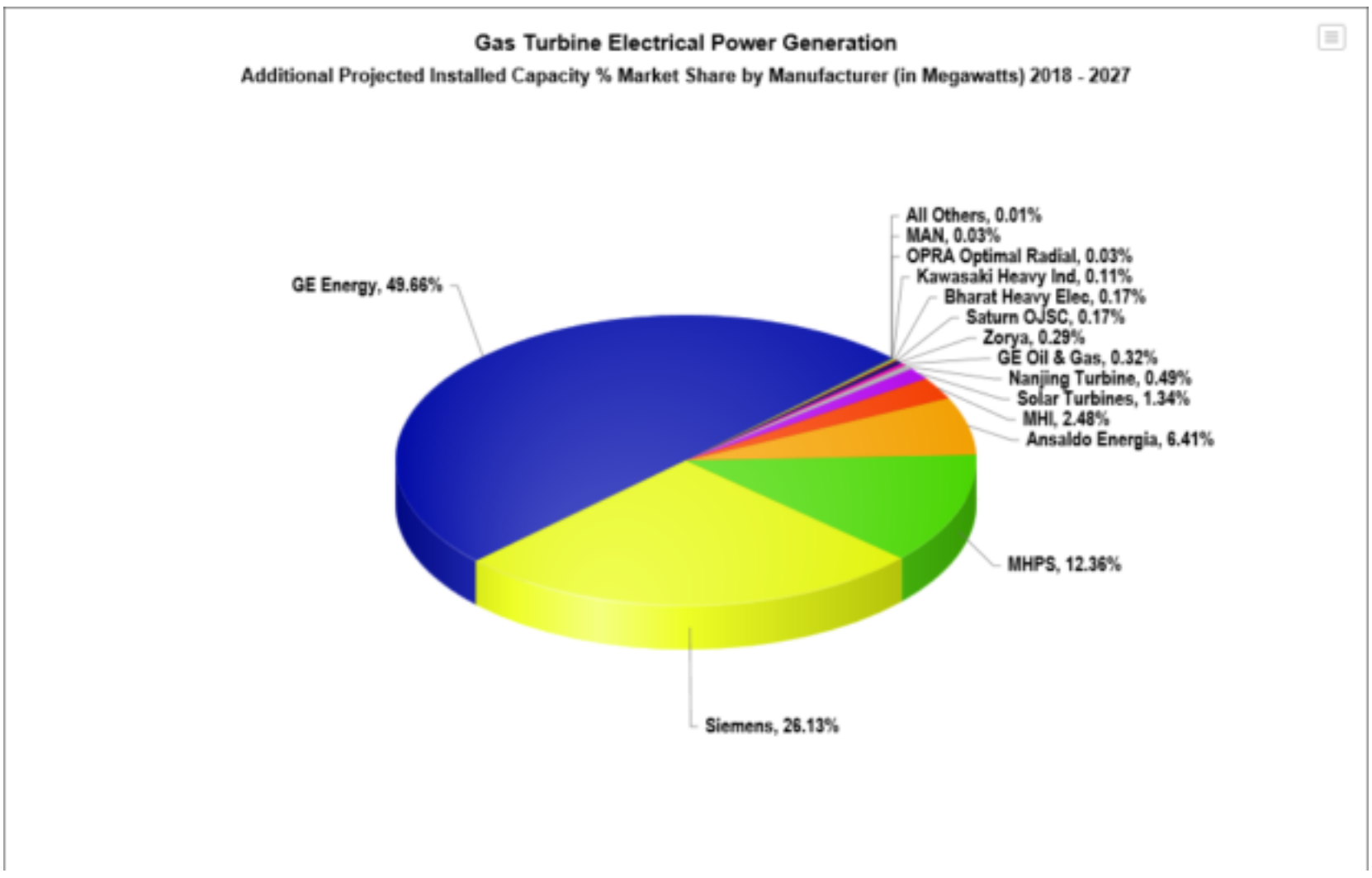
The country needs to commission 20 to 40 GW per year to meet its targets, which is more than five times the power addition rate achieved over the last decade.

According to the National Bureau of Statistics of China, power generation in China declined slightly in 2015, by 0.2%, the first decrease since 1968. This decline was linked to an economic slowdown in China that accelerated in 2016, making a further drop in power demand more likely.

This may well serve as a brake on future investment in power generation capacity in the short term, and possibly longer. The sheer size of China and the scale of its power generation plans are such that even a relatively small

scale-back equates to a lot of lost turbines orders.

Chinese energy policy favors nuclear power. By 2013, power generation investment was already being directed away from thermal and wind power toward nuclear and hydropower projects. Currently, investment planned for these sectors totals $114.4 billion, of which $58.7 billion will be devoted to enhancing the power grid.



OEM overview

The three leading companies in this market sector have been ranked by value of sales (ranking by power output gives the same answer). They account for just over 90% of the world's projected capacity increase over the next ten years. Note that subsidiaries and licensees are included in the overall total.

GE

2018-2027 Production	% of Total
1,608 units	37.27

2018-2027 Production Value	% of Total
$49.88 billion	46.43
2018-2027 Power Capacity (GW)	% of Total
232.6	49.66

General Electric is one of the most diversified gas turbine engine and machine manufacturers in the world. In the gas turbine-powered electrical generation marketplace, its product line spans the power range of 2–750 MW in simple-cycle mode.

GE is enhancing its product range to exploit developing technology. The LM6000 has been continually improved in efficiency and emissions levels, especially with use of the steam injection process. GE's Frame series are also being improved, through technology injection from the CF6 and GE90 airline turbofan programs.

Yet for all its market strength, GE has been hit hard by the economic forces. It has been forced into major restructuring, reductions in staffing levels, and the divestiture of subsidiaries. But the company's established business, licensee, and packaging agreements with more than 30 firms worldwide, have broadened the geographic appeal of GE units.

And the harsh market conditions facing its traditional large-frame gas turbines are being offset by the manufacture of GE LM500, LM2500, LM6000 and LM9000 gas turbines. Almost half of the world's projected increase in energy production will be supplied by GE gas turbines.

Siemens

2018-2027 Production	% of Total
1,034 units	24.0
2018-2027 Production Value	% of Total

$29.21 billion	427.19
2018-2027 Power Capacity (GW)	% of Total
122.2	26.13

Despite the company's acquisition of the Rolls Royce industrial turbine range, Siemen's sales and market share have both declined. Siemens has been restructuring its operations aggressively. It shrunk from 18 divisions in 2013 to five. It raised more than 9 billion euros in merging, selling, or spinning off businesses. It is now investing a substantial proportion of this money in new technologies. Aeroderivatives acquired from Rolls-Royce offer Siemens an opportunity to compete more broadly in power generation.

MHI

2018-2027 Production	% of Total
443 units	10.3
2018-2027 Production Value	% of Total
$16.65 billion	15.49
2018-2027 Power Capacity (GW)	% of Total
69.4	14.84

Mitsubishi Hitachi Power Systems (MHPS) holds third place and has also been hit by declining sales, excess capacity and unsold inventory. It also announced restructuring. It is predicted to account for 10% of unit production, 15% of production value, and 15% of capacity for the forecast period.

Despite the vicissitudes of the last year, the top three companies in the electrical generation gas turbines hold 90.63% by value of the market. In both critical market projection parameters, total unit numbers, and total

capacity, it is clear that the market is highly concentrated and becoming more so. Other participants in the sector are limited to niche applications.

Subdivision of the market shows the dominance of the 250 to 500 MW turbine capacity segment. The 500 to 750 MW segment is growing slowly but has a long way to go before it challenges the 250 to 500 MW segment in capacity terms. It is hard to avoid the impression that the 250 to 500 MW sector represents a sweet spot in electricity generation terms, one where considerations of capital cost, efficiency, environmental protection, and return on investment coincide.

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