

# FLEXIBILIZATION

## THE NEW PARADIGM IN POWER GENERATION

By Frank Klose and Jonas Prudlo

**F**LEXIBILITY IS THE HOT topic in power generation today and is becoming the new paradigm especially in Europe, but also in the U.S. Other regions are expected to follow. A number of European utilities have initiated programs to create value from the process known as flexibilization, but few have done so in a systematic way that captures the strategy's full potential.

The benefits of the approach can be substantial. For example, we estimated the flexibility potential of an average 640-megawatt coal-fired power plant in Germany to be around €4 million in additional annual earnings before interest and tax (EBIT). The key levers for achieving profit-increasing flexibility are reducing the minimum load point—the lowest level of output at which a plant can run efficiently—and optimizing the start-up procedures.

A number of fundamental changes are transforming power markets and putting a premium on flexibility. (For more on this topic, see “European Power Sector: Only the Nimble Will Thrive,” a BCG article by Iván

Martén and Andrew Mack, March 2013). If operators do not tackle the flexibility challenge and fail to fundamentally transform their business models, their plants face the growing risk of becoming obsolete and being relegated to an early decommissioning.

In this article, we present the key ideas identified by a recent BCG study on flexibilization, and we outline the need for utilities to take action. In it, we challenge traditional beliefs that flexibility improvements are mainly a technical issue by showing that if flexibilization is executed properly, it is an asset-light process that requires a holistic organizational transformation.

### Why Flexibility Is Becoming Critical for Power Plants

The substantial growth of renewable energy is leading to a slowly declining and more volatile residual load, which is the power demand that is not met by fluctuating wind- and solar-electricity sources. This load needs to be followed increasingly by fossil power plants seeking to avoid

negative margins associated with production costs that exceed the wholesale market price. More and more power plants can expect to be dispatched in large and relatively rapid shifts, depending on the respective availability of renewable resources. Hence, today's relatively stable generation by base load plants will change drastically in the future. To be competitive, base load plants will have to ramp up and shut down with greater frequency.

The fundamental change in the operating environment creates two challenges for the current business model of fossil power plants. First, as they have almost no variable costs, renewable energy sources reduce energy prices and thus the profitability of fossil plants. Second, they foster a volatile environment. Evidence of these impacts can already be observed in some markets. Relying on wind increases the stochastic or unpredictable volatility of power supply. (See Exhibit 1.) And greater reliance on solar

photovoltaic (PV) creates two systematic price peaks in the morning and afternoon.

In this new operating environment, the start-up costs for fossil plants will rise, which means that many will be unable to operate cost-effectively. Thus, these plants must adapt and become more flexible; alternatively, be decommissioned; or at a minimum, be mothballed and thus no longer contribute to a utility's top-line growth.

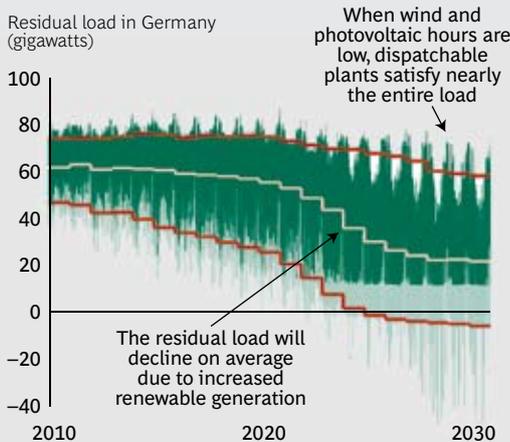
### How Should Companies Approach Flexibility?

Successfully implementing flexibility requires that companies consider a holistic approach. (See Exhibit 2.) Choosing a purely technical solution (such as a one-time upgrade of the facilities) will rarely generate lasting value. A key prerequisite for value generation is a mobilized, enabled organization that is focused on its critical

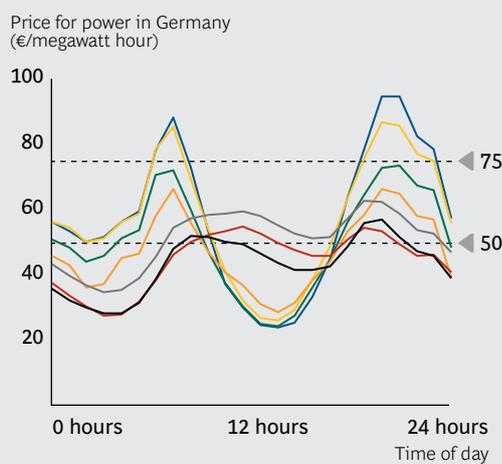
## EXHIBIT 1 | Volatility Is the New Normal for Power Generation in Europe

### Output from BCG's fundamental model

Expansion in wind capacity will create significant increases in stochastic volatility



Photovoltaic power causes systematic volatility with a dual peak



— Percentile  $P_{95}/P_5^1$  — Percentile  $P_{50}^2$   
 ■ Residual load covered by conventional plants  
 ■ Curtailed energy from renewable energy sources

Average Price  
 — 2010 — 2020 Estimated  
 — 2011 — 2025 Estimated  
 — 2012<sup>3</sup> — 2030 Estimated  
 — 2015 Estimated

Sources: BCG Power Market Model, BCG analysis.

Note: The exhibit illustrates the falling demand scenario.

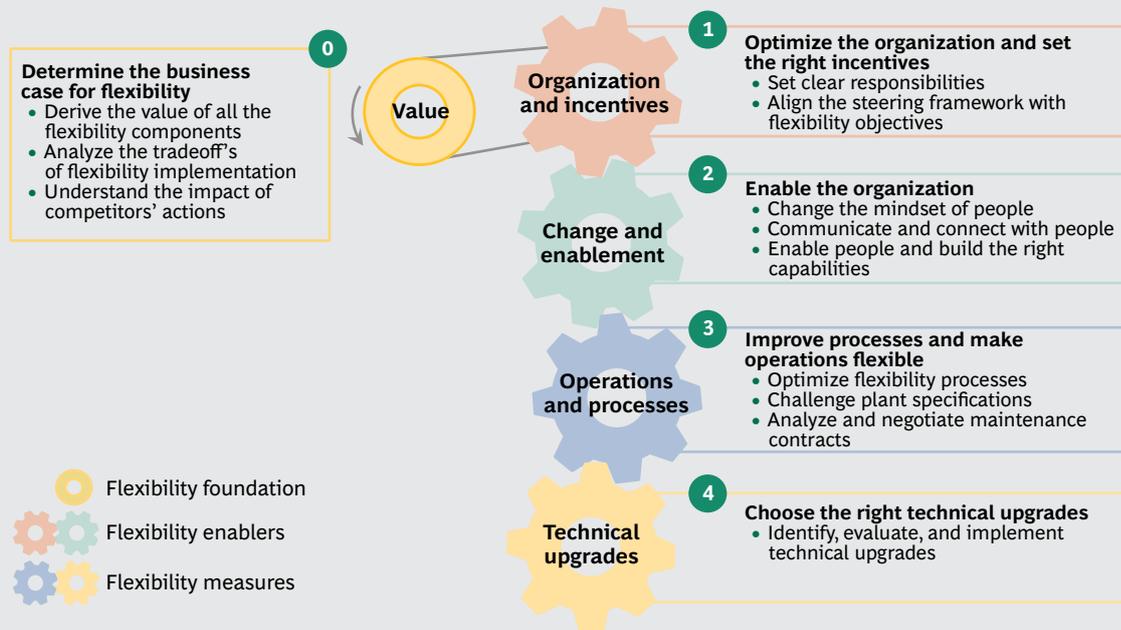
<sup>1</sup> $P_{95}$  is the residual load expected for the 95th percentile of hours in an average year;  $P_5$  is the residual load expected for the 5th percentile of hours in an average year.

<sup>2</sup> $P_{50}$  is the residual load expected for the 50 percentile of hours in an average year.

<sup>3</sup>Data are through November 22, 2012.

## EXHIBIT 2 | BCG's Flexibility Framework Outlines a Holistic Approach

Value, organization, and enablement are prerequisites for tackling operations and technical upgrades



Source: BCG analysis.

processes and the specifications that can benefit from flexibilization. These broader-encompassing measures should be the priority before executives think about more narrow and costly technical investments.

**Determine the business case for flexibility.** To lay the foundation for value generation, companies must determine the business case for flexibility by identifying the value that additional flexibility can add to their plants. Flexibility comes at a cost and benefits vary by plant, so it is important to ensure that the benefits outweigh the costs before focusing attention on possible technical—and expensive—upgrades. All markets in which a plant can earn value—including spot, balancing, and forward markets—need to be considered as well as their potential effects on a utility's broader portfolio. Moreover, benefits and costs should be simulated to determine potential competitor moves and changes in regulation, not only for today but also over the next few decades. This analysis will reveal which plants have the flexibility to provide additional value and which do not.

**Optimize the organization and set the right incentives.** Leadership needs to optimize the organization by empowering the right people. To guide the organization, distinct responsibilities for flexibility improvement need to be clearly assigned, and the roles for generation, trading, and strategy should be clarified. All of these functions need to work smoothly together to achieve the most value from flexibilizing power plants. Organizational roles and responsibilities should be complemented by the financial and operational key performance indicators (KPIs) to steer and measure success in flexibilization. These KPIs should be part of the incentive system for all generation, trading, and strategy functions that impact flexibility. This sets the right targets and provides a clear and common direction. However, these flexibility-specific KPIs should not be included in internal transfer price systems as the additional cost they create will likely outweigh any additional value generated.

**Enable the organization.** Successfully implementing a holistic approach to transformation requires a fundamental rethinking of a plant's operating process

and culture—from its base load operations to the optimization of flexibility. As one senior executive pointed out, “People in the plant need to change the way they work. If you don’t educate them about why that change is necessary, you get nowhere!”

Once this change mindset is instilled, leadership must ensure that the organization—especially the plant staff—fully understands the necessity and the urgency of the initiative. When these prerequisites are fulfilled, two levers for increased flexibility can be pulled: improvements in processes and operations, and technical upgrades.

**Improve processes and make operations flexible.** Procedural improvements can have a significant positive impact on all aspects of flexibility performance. The prototypical example is the start-up process, which in some cases can be accelerated through process improvement without requiring costly expenditures on technical equipment. Another example is improvements to plant specifications, which offer the potential for operating benefits again without requiring any capital expenditures. For example, our studies show that lowering the minimum load point of power plants offers the greatest potential to make value-creating flexibility improvements because such a move can significantly lower starting costs—and thus losses—in market situations when prices would otherwise dictate a plant shutdown.

The reality of today’s new operating environment is that plants that have traditionally been base load plants must achieve drastic improvements to remain competitive. Designed with a fixed-operating perspective and focus, these plants are at a distinct disadvantage if they have to follow a volatile residual load. Since alternations of procedures and plant specifications are likely to increase component stress, companies should take a holistic view, examine all benefits and costs, and regard process improvements as a basis for technical upgrades. Careful assessment can reveal important results. Older plants, for example, often show significant improvement poten-

tial because many of their components were designed to include broader security buffers—and these can be translated into flexibility improvements.

### **Choose the right technical upgrades.**

Opportunities for technical upgrades that cover the most common flexibility requirements are available to all types of plants. However, opportunities to generate value are rare for the more expensive measures such as indirect burning, speed-controlled fans, and variable pressure operations. Most of these types of upgrades will contribute to value generation only if they were driven by the need to replace the components, as when they become worn out or in disrepair. There are more standardized packages and improvement measures for combined cycle gas turbines (CCGTs). By contrast, upgrades for coal- and lignite-fired plants tend to be highly customized and more expensive, yet they often yield a higher potential impact; that is, a higher net return on profitability. To assess the respective opportunities, the individual business case for each plant should be assessed.

## **Utilities Must Take Steps Toward Flexibilization Now**

There are three reasons why utilities must make the strategic and operational shift toward flexibility today:

- When choosing among the plethora of improvement measures, management should focus on those that require **low levels of capital expenditures and have comparatively speedy payback periods**. Taking advantage of these measures requires a holistic approach to transformation that delivers long-term benefits greater than those achieved through a piecemeal approach spending money on narrow and often expensive technical improvements.
- Management is likely to be facing tough decisions concerning the aging fleet of fossil plants—for example, whether to shut down, mothball, overhaul, or extend the lifetime of these plants. This creates a **window of opportunity** for

companies to use more detailed knowledge of additional sources of profitability—such as implementing flexibility—to significantly improve decision making.

- Because the profitability of individual measures is reduced when competitors start to increase the flexibility of their plants, there is an important **first-mover advantage**. Thus, starting the process today will generate greater dividends tomorrow; delays will diminish the benefits that can be realized.

disadvantage as renewable growth is projected to accelerate, forcing conventional fleets to follow an increasingly volatile residual load. Those that don't change will experience losses of thermal efficiency and will put additional stress on their components. Equally important, their opportunity to generate revenue will decrease as will their competitive position. Systematically taking advantage of all the available levers to achieve flexibilization—and moving beyond piecemeal technical solutions—can transform a growing operational risk into a real competitive advantage.

## **N**EGLECTING FLEXIBILIZATION PUTS utilities at a fundamental strategic

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