
ENERGY MARKETS GROUP

Five game-changing factors to consider before investing in the European power market.



**In today's volatile power market,
what you don't know can cost you.**



Navigating the new energy market.

Many in the European power generation industry no doubt long for the relative market tranquility of the late 20th century. The generation plants built and operated then were carbon-fueled or nuclear-powered, with a few hydroelectric plants sprinkled in. The economics were largely stable and predictable, often thanks to regulation that shielded utilities from market fluctuations.

Even in these simpler times, when the market was far less volatile than today, there was still much due diligence required when investors and developers were considering multi-million-Euro commitments in new generation projects.

Today's market is more volatile, with greater variability in energy sources due in large part to the desire to reduce environmental damage. The European Union (EU) is on track to achieve its 2020 goal of reducing greenhouse gas emissions by 20% compared to 1990 levels¹ by reducing its reliance on carbon-based power. In fact, in 2017, Europe produced more of its electricity from solar, wind and biomass resources than from coal.² Seven European Union (EU) countries are already coal-free, and France, the UK, Finland, the Netherlands, Portugal and Italy plan to end coal generation within 10 to 15 years. This transition is occurring more quickly in the western European countries than the eastern.³

As more carbon-based generation plants go offline, carbon-free generation is (for the most part) meeting the growing demand for power. Electricity consumption in Europe increased 0.7% in 2017, the third consecutive growth year, driven largely by an expanding European economy.⁴ In recent years, to replace shuttered plants and meet growing power demands, there has been a development frenzy in wind, solar and other clean generation resources. Still, there remains a strong demand and need to bring new generation sources online, but as more energy resources are injected into the grid, future demand will vary.

Making a decision to enter the market with new energy projects is not clean-cut. Investors and developers interested in determining a project's viability and optimizing profitably face a daunting set of calculations. Market shifts, changing legislative priorities, regulation mandates and evolving technology are only some of the variables that must be considered.

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This paper examines the five most critical variables that investors, developers, and others must recognize in the due diligence process before investing in a new power generation project in Europe.

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— Financial Times

1 <https://www.powermag.com/europes-power-generation-industry-evolves/>

2 <https://www.ft.com/content/bdb138ac-6d63-11e8-852d-d8b934ff5ffa>

3 <https://www.powermag.com/europes-power-generation-industry-evolves/>

4 <https://sandbag.org.uk/wp-content/uploads/2018/01/EU-power-sector-report-2017.pdf>

1. Existing generation sources are still viable... and more reliable.

There is a normal cycle of plant retirement and replacement, but that cycle hasn't been disrupted in recent years. One reason is that many power generation assets continue to operate long after their planned or expected life.

Coal-fired facilities, in general, have proven remarkably durable, continuing to operate far beyond their 25-30-year design life. Nuclear plants, too, are exceeding their expected productive life. Although originally predicted to last 40 years, operators and experts say it's conceivable that nuclear plants could continue safe, productive operation for another 50 or even 70 years.□

Of course, the fact that an asset is old or inefficient isn't the only reason for taking it offline. Environmentalists have greatly accelerated the demise of coal, and incidents like the Fukushima Daiichi nuclear accident have soured legislators' and consumers' view of nuclear power. These forces have ramped up the shift to building new, alternative energy sources, which also come with known – and often serious – shortcomings.

But as the older thermal plants are decommissioned, the reliable baseload replacement has fallen short. This issue was made brilliantly apparent in December 2015 in Germany. A week of misty, still weather reduced the renewable output to a trickle, forcing them to scrounge power from all over Europe to keep holiday lights illuminated. Ironically, the following Christmas, Germany had a glut of renewable power generation that resulted in 35 hours of negative power prices, sometimes as low as -67Euros/MWh (-\$78 USD).

Although the specifics vary based on local government policies and regulation, infrastructure, and energy market differences, the various solutions, discussed in more detail to follow, are equally diverse, such as:

- Additional short-term flexible generation
- New power storage technology
- Hybrid renewable plants
- Demand response systems (DRS)
- Increased interconnections to other grids or networks – for instance, the diagram on the left shows the potential effect of new build and interconnectors on the Great Britain reserve.



⁵ <https://www.scientificamerican.com/article/nuclear-power-plant-aging-reactor-replacement/>

2. Renewable incentives and supply will impact future profitability of both renewable and conventional energy sources.

What's driving renewables

The number of climate-change doubters continues to dwindle, encouraging government and legislative bodies across Europe to take action. Members of the EU are focusing much of their attention on cleaner energy because power generation is largely responsible for man-made environmental issues.

The EU has a set of environmental targets aimed at the energy industry as a whole and particularly on power generation. The two most relevant are targets are to:

1. Reduce CO₂ emissions
2. Achieve 32% of energy from renewables by 2030

While environmental concerns are the primary impetus encouraging more renewable energy, a secondary motivator is the EU's hope to decrease dependence on fuel and energy imports since the EU's renewable resources are indigenous, plentiful and varied, including solar to the south, hydro to the north, and wind both offshore and onshore. Currently, the main natural gas provider is Russia, while liquefied natural gas is sourced from other non-European countries.

The EU and member-country governments have supported the expansion of renewables with a combination of incentives. This resulted in considerable investment focused both on improving renewable efficiency and reducing the cost of deployment. The increased activity in the renewables market has improved economies of scale which, in turn, have helped to reduce the price of renewable energy, especially wind and photovoltaic cells.

Even though these incentives are diminishing, this isn't likely to stem the surge in renewables. The competitive price of generation is such that new projects are now being built on their own merit, reducing the risk to investors and developers. With the exception of offshore wind, renewable projects are highly scalable, which enables a wide range of investors to participate in power generation and related markets.

The profitability picture

There are many winners as a result of the renewables surge. In the long run, the environment will benefit from reduced emissions. From a commercial standpoint, there is the broad benefit of new jobs, new industries and economic uplift, particularly in remote areas where renewables are often located.

On the losing side are the incumbent market players, particularly fossil-based generators, which face new challenges. Europe's power sector is under never-before-seen pressure, including changes in government policy, technological advances, and falling renewable costs, that are undermining the economics of traditional power plants. More than half of the EU's 619 coal-fired power stations are losing money. Stricter air pollution rules and higher carbon prices will push more conventional plants into unprofitability, according to the analyst Carbon Tracker, with 97% of the plants losing money by 2030.

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– Carbon Tracker

Building new onshore wind and solar farms is projected to be less expensive than operating existing coal plants by 2024 and 2027, respectively.

– The Guardian

Renewables, especially solar and wind, have very low short-run marginal costs and are often given priority in dispatch. Conventional generation finds it difficult to recover their costs. Furthermore, rapidly falling renewables costs are on track to make building new wind and solar farms cheaper than continuing to run existing coal plants by the mid-2020s. Coal in Europe is in what has been called a “death spiral,” with seven nations including the UK already having announced the end of coal power by 2030 or earlier. Building new onshore wind and solar farms is projected to be less expensive than operating existing coal plants by 2024 and 2027, respectively.⁸

There is also an expected impact to consumer pricing related to renewables. As the growth and penetration of renewable sources continue,

there is the potential for increased competition and a reduction in electricity pricing, which could impact profitability. Further, the commercial or business case for renewables can become challenging due to cannibalization as renewable resources compete with one another. However, this raises opportunities for new technology and for market players like energy storage providers and demand-side response providers to manage the variability of renewable generation.

The drive for increased renewable penetration now appears unstoppable for the next generation as a combination of lowering prices, environmental demands, and consumer pressure make renewables the best place to invest in the power market.

3. New and evolving technologies will forever change the energy generation landscape.

Today, some European countries either are meeting or are on track to meet 100% of their electric power requirements with renewable energy. Most can already achieve that target during times of low demand and/or high renewable generation. New technologies continue to expand the duration and frequency of instances when renewables can completely meet their country's power needs, such as:

- Battery storage systems
- Flexible generation plants
- Demand response systems

Battery storage systems

One of the most promising technologies to address the variability of renewables is battery storage. These systems excel at short-term grid stabilization, rapidly accepting or injecting power to help ride through a cloud passing over the solar panels or a lull in the wind.

With storage, the peaks and troughs of generation can be leveled, transitioning renewables to be a baseload-power provider. New systems are being deployed that can feed networks for several hours, moving far beyond today's very short-term applications.

The utility of these battery systems has been proven and, more recently, so has their profitability. A recent headline from Electrek, an online news site tracking the transition from fossil fuel to electric transportation, announced that “Tesla's giant battery in Australia made around \$1 million (AUD) in just a few days.”⁹ Another example is the 100MW/ 129MWh Powerpack project in South Australia, owned by Neoen. The largest such system in the world at the start of 2018, it was paid up to \$1,000/MWh to charge itself. The installation also demonstrated this technology's stabilization function when a coal generator failed. The batteries provided a burst of power to normalize the grid, demonstrating the disruptive nature of new technology, and this battery system was installed in a mere 100 days.

⁸ <https://www.theguardian.com/environment/2017/dec/08/death-spiral-half-of-europes-coal-plants-are-losing-money>
⁹ <https://electrek.co/2018/01/23/tesla-giant-battery-australia-1-million/>

China is developing a 200MW / 800MWh vanadium-flow battery that will be a multi-purpose asset, meeting peak load demands, enhancing grid stability, and enabling black starts in case of emergency. It is expected to shave 8% off the peak load of Dalian, China, when it comes online in 2020. It will also reduce China's nearly 20 percent of curtailment of renewable production.¹⁰

According to a recent Bloomberg NEF report, "The arrival of cheap battery storage will mean that it becomes increasingly possible to finesse the delivery of electricity from wind and solar, so that these technologies can help meet demand even when the wind isn't blowing and the sun isn't shining. The result will be renewables cannibalizing the existing market for coal, gas and nuclear."¹¹

Flexible generation plants

The concept of flexible generation takes in a variety of technologies that encompass both carbon-based and renewable energy sources.

Combined-cycle power plants, for example, greatly enhance the efficiency of turbine generation by using the exhaust heat to create steam. Power is generated both by the spinning primary turbine and through steam generation at a secondary turbine. These types of systems deliver efficiency in the 60% range, compared to the typical 35-40% for a gas turbine, but are complex to operate and optimize.

Greater generation efficiency is also achieved through **combined heat and power (CHP) plants** in a process sometimes referred to as cogeneration. This technology can achieve efficiencies of more than 80% but is limited by the need to locate the plant relatively near where the heat is consumed. This is very popular in industrial processes or facilities that require heat.

Flex plants provide a means to overcome the cost of piping gas from remotely located production fields to the point of use by converting the gas into electricity at the production site. Rather than lay costly pipe, operators bring energy to market via power lines, at a much lower transmission cost.

Hybrid renewable technology can be widely applied at almost any solar or wind facility. This combines renewable generation with co-located battery storage, enabling operators to reservoir power, balance the grid and ride through the inevitable power dips. Enhancing reliability, this hybrid technology will allow providers to participate in new, higher-value markets.

Demand response systems

Another technology advancement addressing the need for more flexibility is demand response systems (DRS). Demand response systems adjust demand for power rather than the supply, encouraging use outside of the daily peak periods and thereby better leveling the load on generation assets.

For the majority of the day, generation capacity exceeds demand. But power producers must have the capacity available to meet consumer needs during the few peak-demand hours of the day. Much of that capacity is unused and unproductive the remainder of the day. DRS implementations can be as simple as variable power pricing but may also incorporate smart meters and other technology. Demand response management systems are a useful way of spreading load to lower peak demand, reducing the need for capital investment in new plants.

These new technologies are being used today and will see broader deployment as they further mature and become more affordable. However, these technology changes are disrupting the energy markets in ways that are difficult to predict and not yet fully understood. Traditional energy trading processes and practices are being turned on their head. Because renewables are often produced far from the point of use, transmission and distribution networks must be reconsidered. The advances in technology require an accompanying transformation in the way power is bought, sold and delivered.

¹⁰ <https://electrek.co/2017/12/21/worlds-largest-battery-200mw-800mwh-vanadium-flow-battery-rongke-power/>
¹¹ <https://about.bnef.com/blog/batteries-boom-enables-world-get-half-electricity-wind-solar-2050/>

4. Interconnectivity of power sources will continue to forge new supply and demand interdependencies.

Interconnection benefits

The various national grids that carry power to European consumers are relatively isolated from one another, impeding the ability to freely move these new energy sources from areas of supply to those with need. This was less of an issue when most power was provided by carbon-based generation facilities located in each country. Renewable facilities, on the other hand, need to be sited where the natural resources – wind and sun – are most plentiful. This has driven the EU to include targets for increased cross-border interconnection capacity as one of its efforts to increase renewable use. The cross-border interconnection level should be at least 15% of the installed electricity production capacity in the country.

A more-robust range of interconnection options would enable more-efficient utilization of the diverse portfolio of energy sources on a pan-European level. It would provide better balancing between areas where renewable generation is low and the high generation resources like hydro power from the Nordic region, large-scale offshore wind in Great Britain and large solar in southern Europe.

To this end, the EU joined in a number of projects of common interest, including a North Sea offshore grid, a north-south interconnection between the Iberian Peninsula and the rest of Europe, and the Trans-European Network for Energy (TEN-E) strategy. TEN-E is focused on linking the energy infrastructure of EU countries, including development of nine “priority corridors.” These are large-scale, multi-country projects designed to enhance grid flexibility and energy independence. There are also smaller-scale endeavors, including a commercial project to connect Norway with Great Britain.

Interconnection challenges

The ability to more-freely exchange power across borders will result in price convergence between connected countries that could affect the commercial viability of the interconnections. These interconnections will facilitate transmission of surplus power to other countries or regions where demand exists and electricity prices are higher. But when this transfer of power occurs, it will likely drive prices down to the point where both countries have the same cost. Since the interconnections make their profit from the price differential, the commercial rationale is eliminated.

Beyond the impact on the interconnections, the ability to import electricity from a low to high-price region will also change the economics of the generation assets. The more-expensive assets in the importing region will be pushed to the bottom of the merit order and be called on last. As the interconnections succeed in providing lower-cost energy, the expensive plants in the importing country will become redundant and unnecessary.

Fortunately, there are other purposes for the 120+ interconnectors planned for Europe:

- Use the interconnectors to buy power for market balancing – these costs are often unrelated to normal prices and are up to 10 times higher
- Move renewable energy from source to market, reducing dependence on carbon-based power generation.
- Cope with power peaks in markets by using capacity “next door,” reducing need for over capacity
- Buying power to prevent blackouts in emergency

All signs indicate that interconnectors will become a fundamental part of the European energy landscape.

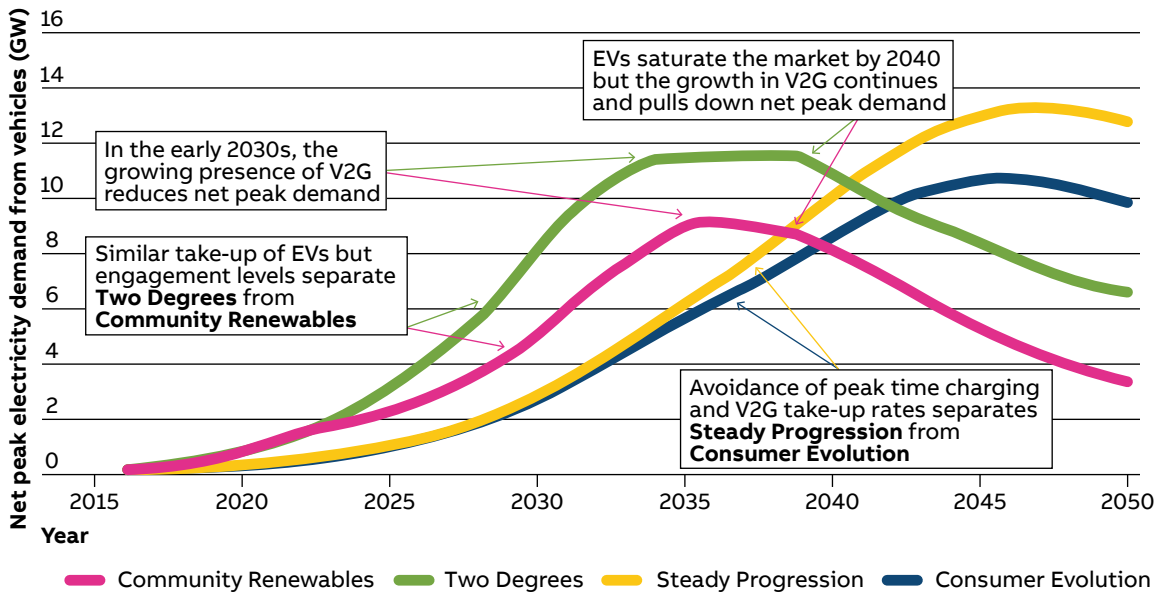
5. Electric vehicles and rail systems have the potential to create exponential growth in power demand.

The percent of total UK power production consumed by transport has grown rapidly, from 16% in 1990 to 26% in 2016, and will likely to continue to grow.¹² This consumption growth is currently mainly in rail electrification, but electric road transport is poised to grow as well. A quarter of UK carbon emissions come from road transport, of which road transport accounts for over 90%.¹³

The large role transport plays in emissions across the EU created strong impetus to decarbonize the transport system. The UK government’s industrial strategy, The Road to Zero, sets a goal of zero emissions by 2040. Steps include ending the sale of new, conventional petrol and diesel cars and vans by 2040, replaced largely by electric vehicles (EVs).¹⁴

Significant additional demands will be placed on power providers as the number of EVs grows, and grow it will. Most of the major carmakers already offer EVs, nearly 500 new electric models on sale, accounting for one in five new-car sales worldwide, by 2025.¹⁵ Almost all auto makers have committed to shifting from gas-powered to electrically-powered vehicles in the future, and some announced intentions to be all EV. Volvo and Jaguar Land Rover have already made these announcements.

The market’s enthusiasm for EVs is evident from indicators like the Tesla share price, which has increased almost 20-fold since 2010.¹⁶



Annual demand from EVs¹⁷

¹² Department for Business, Energy & Industrial Strategy and Department for Energy & Climate Change

¹³ UK government report, http://data.parliament.uk/DepositedPapers/Files/DEP2018-0683/The_Road_to_Zero.pdf

¹⁴ Ibid

¹⁵ Wall Street Journal, <https://www.wsj.com/articles/start-your-engines-the-second-wave-of-luxury-electric-cars-1529675976>

¹⁶ NASDAQ website, <https://www.nasdaq.com/symbol/tsla/historical>

¹⁷ UK National Grid (July 2018). “Future Energy Scenarios.” <http://fes.nationalgrid.com/media/1363/fes-interactive-version-final.pdf>

These new EVs will create a huge additional load on the grid. The typical EV used to commute 15 miles each way consumes about 7.5 to 10KWh/day¹⁸, about the same amount of power consumed by an average household.¹⁹ An EV in each home, therefore, would double today's residential power usage.²⁰

A new load of this magnitude requires changes to ensure the availability of sufficient energy on demand. At the generation or wholesale-market level, high demand and scarce capacity could

increase prices. ABB's Great Britain Reference Case concludes that we are likely to see some flattening, and even reduction, in market price in the short term. This is due in great part to lower natural gas and oil prices. However, in the medium- to long-term, the increased demand resulting from growing adoption of EVs will result in an upward push on electricity prices. The migration from petrol/diesel to EVs in Europe will likely cause the biggest growth in electricity demand since the creation of the national grids across Europe after WWII.

Still considering an investment in the energy market?

Navigating the variables can seem daunting, but the opportunities for profitable new power generation and transmission/distribution that exist throughout Europe make the risk worth the gain. As in all commercial investments, potential problems and pitfalls exist. That's why it's critical to conduct a thoughtful evaluation of market factors to balance opportunity, cost and risks before making a move.

In addition to the five considerations explored here, there is much more that should be considered before investing in a new power generation project. Unfortunately, adequate due diligence of the many

variables and the complexity of the energy market requires much more capability than even the most carefully-crafted spreadsheet can accommodate.

Calculating the financial viability of these projects requires a purpose-built modeling framework that considers the complex interactions between markets and generation resources in an integrated, pan-European market. It's worth noting, however, that calculations are only as good as the data used, which is why it is critical to identify modeling and data supply partners with deep industry expertise and access to a broad spectrum of relevant data and market modeling to provide decision-making support.

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¹⁸ ABC News, quoted on ItStillRuns.com, <https://itstillruns.com/far-americans-drive-work-average-7446397.html>

¹⁹ Calculations based on information from <https://pushevs.com/2016/11/23/electric-cars-range-efficiency-comparison/> and <https://www.statista.com/statistics/517845/average-electricity-consumption-uk/>

²⁰ ibid

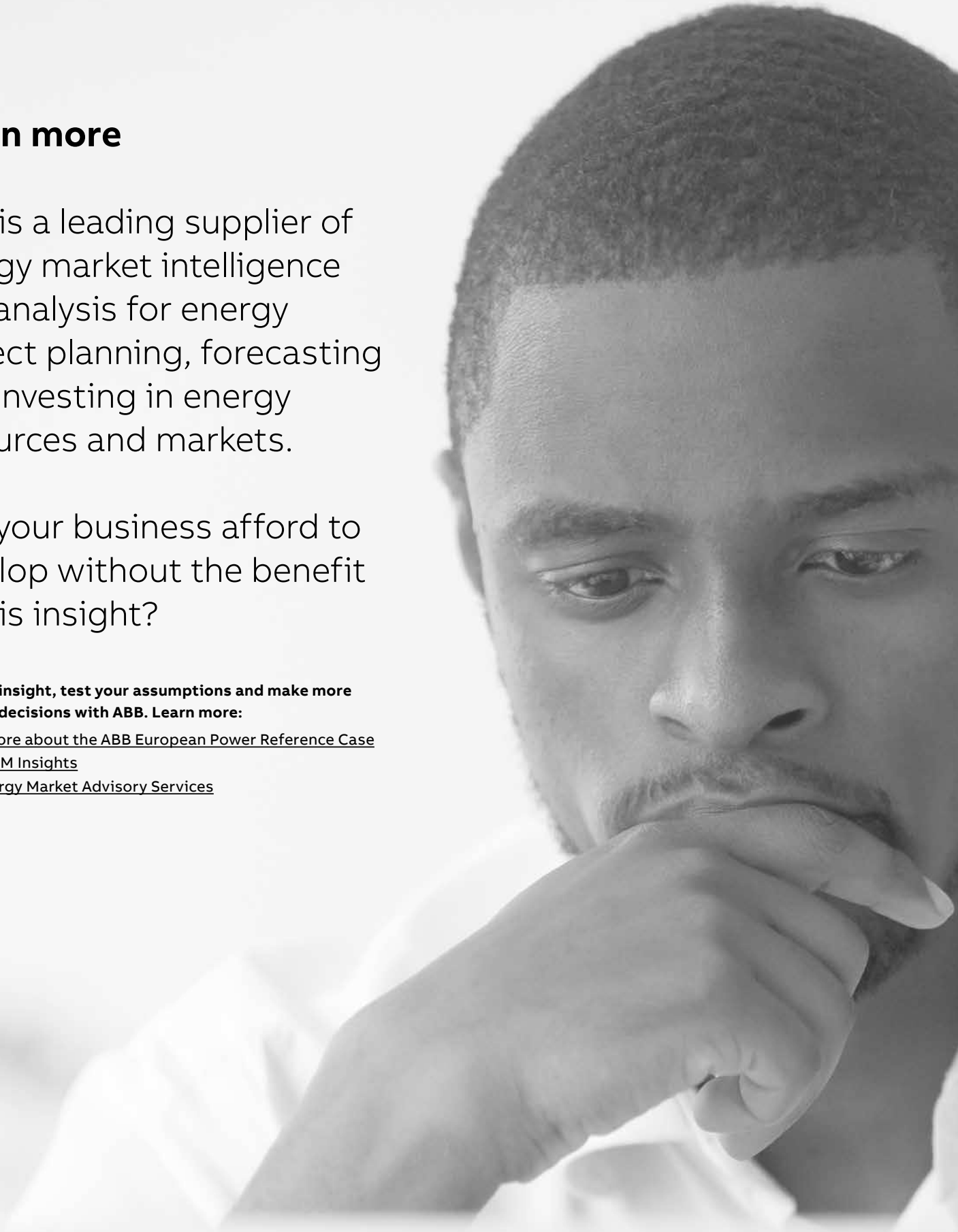
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