

EXECUTIVE SUMMARY

This report reviews gas and coal competition in the EU power sector. It looks at recent developments and analyses the key drivers determining the future dynamics of this competition: gas, coal and carbon dioxide (CO₂) prices, EU regulation, in particular on emissions of local pollutants, national policies, technical and financial aspects. It highlights the deepness of the crisis of the EU electricity system and that of natural gas in the power sector:

- Gas and coal competition does not favour gas which has seen its demand by the power sector shrinking in the past three years;
- Security of electricity supply is at risk as unprofitable gas power plants are closing and old coal stations are being retired, while at the same time flexible generation is needed to back-up intermittent renewable energy sources (RES).

The European paradox

Technical, environmental and financing parameters favour natural gas over coal...

Natural gas has many advantages over coal in the power sector. Combined cycle gas turbine plants (CCGTs) offer higher efficiency, lower CO₂ emissions, relatively quick and cheaper construction, modularity, less local resistance to the siting of new plants, and more flexibility for quick ramp up of production.

Power capacity expansion in the past thirteen years clearly indicates that gas was expected to facilitate the large-scale deployment of variable RES. Since 2000, RES and natural gas installed power capacity has increased by 169 GW and 121 GW respectively. Over the same period, the coal fleet has been reduced by 13 GW.

...but economics dictates a preference for coal

Despite the numerous advantages of natural gas over coal, the evolution of commodity and carbon prices and the fast development of RES have made gas-fired generation a loss-making business, even for the most efficient and newly-built gas-fired plants.

- **High gas prices relative to coal and the collapse of CO₂ prices have eroded gas competitiveness**

Gas competitiveness has been eroded by the decrease in coal prices. The collapse of CO₂ prices since 2012 has reinforced the competitiveness of coal against natural gas. US shale gas production has displaced coal in the country's power mix. Faced with a shrinking market at home, American coal mining companies have turned to overseas coal markets. The inflow of US coal, on a market already well supplied, has created a supply glut and led to a sharp decline in coal prices. Coal prices declined by 32% between the middle of 2011 and the end of 2013. At the opposite, gas prices, still largely linked to oil prices, increased by 42% between 2010 and 2013, in line with oil prices. **The recent fall in gas prices (a decline of 29% for spot prices in the first four months of 2014) does not change the competitiveness of coal over natural gas. As coal prices have also declined, coal is three times cheaper than natural gas on an energy equivalence basis.**

- **Gas demand by the power sector has shrunk by one third**

During the past three years, gas demand by EU power generators decreased by 51 billion cubic meters (bcm), or one third from the historical peak reached in 2010. This is a reduction equivalent to the total French gas market. The share of natural gas in the EU electricity mix fell from 23.6% in

2010 to 19% in 2012. At the opposite, coal-fired power stations had been operated at high loads, increasing coal demand by the sector. Coal demand increased by 10% between 2010 and 2012 (it decreased in 2013) and the share of coal in electricity generation amounted to 28% in 2012.

These trends have put a halt on the declining trend in CO₂ emissions from the power sector in some key countries despite the fast rise of RES.

■ RES push natural gas out of the merit order

In 2012, RES (including hydro) generated 23.5% of EU electricity and overtook natural gas for the first time. The fast deployment of wind and solar has displaced peak and mid-merit conventional power plants and contributed to a fall in wholesale electricity prices.

Low power prices have reduced the profitability of power generation. The trend has been particularly acute for gas power generators which have been faced with increasing gas prices. The clean spark spread (the measure of profitability of gas power plants) has been negative since the beginning of 2012, meaning that on average gas power plants have lost money. At the opposite, thanks to the decrease in coal prices and the collapse in CO₂ prices, the clean dark spread (the measure of profitability of coal power plants) has remained positive.

RES, which have low or zero marginal costs, push out energy sources with higher marginal costs, in the merit order dispatch of power plants. **Gas-fired power plants, which have high marginal costs, have been the first to be pushed out from the system, decreasing their running hours.** In Germany, the average load factor of gas-fired power plants declined to 21% in 2013. In Spain, the load factor of combined cycle gas turbine (CCGT) plants has plunged from rates consistently over 50% until 2008 to an average of just 11% in 2013. The rapid increase in RES also means that more often the price of electricity is set by lower marginal cost energy sources, preventing gas-fired power plants to recoup their fixed costs, and even in some cases, their operating costs.

Security of electricity supply at risk with closure of unprofitable gas plants and retirement of ageing coal fleet

■ Massive closures of gas capacity

Faced with low running hours and declining/negative margins, gas power operators have started to mothball or close their loss-making plants. **At the end of 2013, 24.7 GW of gas-fired power capacity were idled, closed or at risk of closure, most of them in northwest Europe. This represents 14% of the EU installed capacity.** The first plants to be closed were the old plants which have lower efficiencies than new builds. However, the further deterioration of market conditions has led utilities to mothball new build plants with efficiency of 58-60%. **If all gas power plants currently under review by major European utilities are closed, this may lead to the closure of about 50 GW of capacity by 2015/16, or 28% of the current capacity,** while at the same time this capacity is needed to ensure security of supply when wind and sun are not producing.

■ Coal renaissance may be short lived

While coal plants have been operated at high loads so far, **RES development is starting to push out hard coal from the merit order.** In 2013, EU coal demand decreased by an estimated 5%. In Spain, wind became the first primary source of electricity in 2013 (21% market share), while coal saw its share falling to 14.6% from 19% in 2012. Moreover, the rapid development of RES, which so far had only impacted gas-fired power plants, is starting to take its toll on hard coal power plants' profitability.

This trend is reinforced by EU regulation on air quality. The impact of the Large Combustion Plant Directive (LCPD), which restricts the emissions of local pollutants (SO_x, NO_x emissions and small particulates), is already felt on the EU ageing coal fleet: 15.8 GW of coal-fired capacity will be closed by the end of 2015 at the latest, mainly in the United Kingdom and France (several plants are already closed). The Industrial Emission Directive (IED), which succeeds the LCPD from 1 January 2016, will further restrict the emissions limits. For old coal power plants (40% of the coal fleet is more than 40 years old), there will be no incentive to invest in depollution equipment and an **estimated 50 to 55 GW of coal power capacity may close by 2020/2023 at the latest. Overall, the current capacity may be reduced by about 65 to 70 GW, due to the combined effect of the LCPD and IED, representing a third of the coal fleet capacity.**

■ 115-120 GW of gas and coal capacity to close/at risk of closure

Altogether a capacity of 115-120 GW is closing or at risk of closure, representing a third of gas and coal capacity in the EU. These trends pose a serious challenge for security of supply as thermal power generation is needed to back-up variable RES. The building of flexible power capacity required to support the development of RES is threatened by the lack of market signals and adverse investment environment. The current situation has the potential to unfold into a major structural crisis.

Although reserve margins are still adequate in most countries, when the anticipated mothballing/closure of uneconomic plants, retirement of ageing coal plants, as well as delays or cancellations of new projects, are taken into account, the situation is different in several countries. In the UK, for instance, despite the expansion of RES, the reserve margin is falling. While old coal plants are closing (as expected), the (unexpected) mothballing and early closure of gas plants is reducing the power margin from 6% in 2013/2014 to 4% in 2015/2016, a level which puts the UK system at risk.

■ Power utilities are no more investing in thermal power generation in the EU

The lack of future for some gas and coal power plants has led some European power utilities to write down power generation assets. In 2013 only, key utilities in the EU reported power generation asset impairments of €15 billion, the same level in one year than what they reported in the 2010-2012 period. Faced with adverse market conditions in the EU, power utilities are adapting their strategy to the new conditions. They are moving from the traditional business model based on large-scale electricity generation to new business models focused on renewable generation and new sustainable and smart products and services. They are no more investing in thermal power plants in the EU. They focus thermal power generation expansion away from the region with investment in growth markets (Turkey, Russia, Eastern Europe, Latin America, Asia). **There is an urgent need to rebuild confidence in the European electricity market.**

■ A new market design is required

As the market does not provide the right signal for investment in conventional capacity, a new market design is urgently needed. A sustainable electricity market design needs to ensure that low-carbon and fossil fuel-fired power plants have viable business models with manageable investment risks.

To address the immediate security of supply concerns, several EU countries are introducing capacity markets in order to provide additional stimulus to investors and ensure that a sufficient amount of capacity will be available. The design of such mechanisms is however extremely complex with the need i) to balance the amount of capacity needed to ensure security of supply with demand-side

response and ii) to integrate interconnection capacity and the development of cross-border trade with the aim of achieving a fully EU integrated Internal Electricity Market.

These mechanisms do answer to the immediate concern: keeping the lights on. A more profound reform of the entire power system will nevertheless be necessary, including structural reform of the EU ETS, integration of RES into the market, and completion of the Internal Electricity and Gas Markets.

Gas and coal prices trends will continue favouring coal

The relationship between coal, gas and CO₂ prices is a key determinant of the competition between gas and coal in the power sector and will remain a driver of fuel switching. Although there are many uncertainties in the evolution of gas and coal prices, **coal is expected to retain its competitiveness against natural gas in the future too**. CO₂ prices, which are mainly driven by policy decisions, may change this situation, depending on structural reforms of the EU ETS.

■ Downward pressure on gas prices

There is downward pressure on future European gas prices, coming from indexation on gas hubs, a wave of new supplies (pipeline and above all LNG) and potential shale gas production in the EU.

At short term, the influence of oil prices will still dominate for several years. Despite the declining share of European supplies tied to oil prices, long-term contracts that make most of European pipeline imports, some of them running up to 2030, are still 50% linked to oil. In the coming years, marginal supplies needed to cover an increase in European gas demand (or decline in EU production) will be determined by supplies which either are linked to oil (pipeline gas from Russia) or have to compete with Asia (and Latin America) where LNG prices are still linked to oil prices and much higher than European prices. Seasonal drops in gas prices, as currently experienced, can be expected depending on the availability of uncontracted LNG supplies.

At medium/long-term, with a growing share of gas supplies sold based on hub prices, prices will be determined to a much larger degree by actual supply and demand fundamentals and by gas-on-gas competition between various suppliers competing for market shares. The move to gas-on-gas competition needs to be accompanied with the development of supply sources, both domestic ones and new sources, in particular in southeast Europe, and investment in new pipelines and interconnectors, to allow a wider range of supply sources to reach EU gas customers and competition between supplies to develop. A higher share of LNG imports is foreseen. This is in line with the high regasification capacity available in Europe which theoretically would allow the imports of 199 bcm/yr. Numerous LNG export projects are being developed by new sellers (US, East and West Africa) that will offer the possibility to further diversify EU gas supplies. In addition to new supplies from the Caspian region, East and West Africa, the Mediterranean, possible production of shale gas in the EU and LNG exports from the US based on Henry Hub prices may add competitive pressure and put a cap on European prices, although it is unlikely that this translates into large reductions in prices.

■ Coal prices have reached a bottom

In contrast with natural gas, the coal market is a global and competitive one. Prices are similar on the Pacific and the Atlantic basins. The supply glut that has developed on international markets has led to a large decline in coal prices.

China, which was still a net exporter in 2008, has become a net importer since 2009 and **became the world's largest coal importer in 2011**. It now represents almost a quarter of world steam coal imports. Due to its size on the international coal market, China has become a price setter for steam

coal and **policy decisions taken in Beijing affect the price of coal delivered to other Asian countries and European buyers**. Yet China remains the world's largest producer of coal. Its imports are only a small part of its supply. They are driven by **coal price arbitrage between domestic and international coal prices**. This makes difficult the forecast of future global steam coal trade and prices as it depends on China's market development and government policies. The Chinese government is determined to reduce the share of coal in the energy mix. This may drastically reduce China's coal imports. However, while the commitment of the government is clear, the speed of change remains uncertain.

Despite these uncertainties, the growth in global trade is expected to slow down in the next few years. The global supply overhang is expected to persist in 2014 and 2015. As prices have certainly reached a bottom, no further declines are expected. Mining companies have started to close their highest cost mines and focus on cost reductions. The rebalancing of the market is not expected before 2016 and **only a slight recovery in coal prices** is expected as there are plenty of new coal mine developments in the pipeline.

■ CO₂: Can the Phoenix rise from the ashes?

While the EU Emission Trading Scheme (EU ETS) was introduced to provide a price signal for investment in low-carbon technologies, the massive oversupply of allowances has driven down carbon prices to such low levels that **the EU ETS plays virtually no role at all in influencing investments into new generation capacities**. With the adoption, at the beginning of 2014, of short-term measures (backloading) and proposed in-depth structural reforms, the European Commission hopes to address the present EU ETS flaws and promote a well-functioning carbon market. The reform is urgently needed to give the appropriate signal for future investment in the power sector. However, while CO₂ prices have settled at €5-6/t since the beginning of 2014, a level of €30/t would be required to foster switching from coal to gas at prices observed at the beginning of May 2014 (€50/t at gas and coal prices in January 2014), a level which is not attainable, nor desirable, at short term. It should also be mentioned that before any major investment decisions in the power sector are made based on the EU ETS, the price needs to reach a significant level and stay there for a prolonged period of time.

Competition between gas and coal is not driven by commodity and CO₂ prices only: governments play a key role

Taxes on fossil-fuel generation and other national policy measures play a key role in shaping the competition between coal and gas in the power sector, in addition to the EU overarching climate and energy policies. Taxes (carbon tax) can reverse the current competitiveness of coal against gas. The introduction of emissions performance standards (EPS) can even prevent the building of new unabated coal stations.

The three largest EU coal consuming countries – Germany, Poland and the United Kingdom – have mixed approaches on the role of coal in their electricity mix. **The analysis of their national energy policies shows clearly that the path to a low carbon economy can be achieved differently and at different timeframes according to national preferences for one source of energy and trade-offs between the objectives of sustainability, competitiveness and security of supply.**

In Germany, competition between coal and gas is left to market forces and is not specifically addressed by the *Energiewende*. The fast expansion of wind and solar has pushed out natural gas from the merit order. This has resulted in increased coal consumption by the power sector. The

country is closing its old inefficient coal-fired plants and replaces them by high-efficient ones, which will help reducing CO₂ emissions. Germany is also developing its lignite resources, the second largest in the world, to feed its new lignite-fired power plants. The carbon emission target of the German energy sector will fall below the current CO₂ emissions from coal power plants before 2030. CCS may have helped to decarbonise the electricity mix. However, it encounters widespread opposition, above all against carbon storage, throughout large sections of the population. As a result, without the application of CCS technology, it can be expected that coal consumption for power generation will be restricted in the long term.

Coal dominates the electricity mix in Poland. For security of supply and independence objectives, exacerbated by the Russia-Ukraine crisis, this role is expected to continue in the future. The new Polish energy strategy, released in November 2013, concludes that coal provides the cheapest and therefore the optimal, solution to supply Poland's power also in the long term. Diversification of the energy mix is nevertheless pursued and includes renewables, LNG, shale gas, and nuclear. The Polish power sector faces many challenges. One of the urgent issues is to replace the ageing coal fleet. As most options to diversify the energy mix are medium to long term ones, there are few alternatives to building new coal fired power plants. Nevertheless Poland's overwhelming reliance on coal could potentially drop following the further coupling of the regional power markets and increased cross-border electricity flows.

In the United Kingdom, by contrast, the energy and climate policy does not encourage the use of coal. The introduction of a carbon tax in 2013 penalises coal burning. The increase in the carbon floor price, despite its recent freezing, is expected to reverse the current balance between clean spark and dark spreads to the benefit of natural gas. Furthermore, generators with old coal plants will have little incentive to invest in depollution equipment and may choose to close their plants. Gas burning is expected to increase with the closure of coal plants. The UK is implementing a capacity market to address the issue of generation adequacy, which may allow mothballed gas plants to restart operations and fosters investment in new gas plants. The government has also adopted an EPS which prevents the construction of new unabated coal stations. At longer term, the efforts deployed by the government to develop a CCS industry, may well allow clean coal resurgence.

Future gas and coal contest: reinventing a business case for gas in the power sector

Regulatory uncertainties make the future role of gas in the power sector very difficult to predict. Projections by major institutions (IEA, EUROGAS, EURELECTRIC) show that a resurgence of gas demand in the EU electricity mix is not foreseen during this decade. At longer term, the role of gas depends on a complex interplay of global and European market forces, and of European and national energy policies and market designs. **While coal plant closures do not depict a bright future for coal use in the power sector, they do not mean higher gas demand by the power sector due to poor economics of gas-fired generation and regulatory uncertainties.**

Three main conditions are needed to reverse this situation and allow clean and flexible natural gas to play its role as an enabler of the transition to a low carbon economy:

■ Decarbonisation and reform of the EU ETS

The reform of the EU ETS, which is urgently needed, should allow natural gas to play a key role in the decarbonisation of the EU electricity system. A reduction of CO₂ emissions by 40% by 2030 could hardly be met otherwise.

■ Gas prices and market liberalisation

The further liberalisation of gas markets and supply diversification should allow gas prices to be determined by market fundamentals and liquid gas markets to further developed, a condition for the use of gas in the EU power sector characterised by a growing level of variable generation.

The competitiveness of natural gas in the power sector must be addressed, for instance by developing partnerships between suppliers and utilities and exploring new sales and purchase agreements including the specificities of the EU electricity sector. This requires, however, that gas exporters and importers share the same vision on the evolving EU gas and electricity market and are ready to cooperate to rebuild the competitiveness of natural gas in the power segment. The power sector is still the segment which offers the largest opportunity to increase gas consumption.

The exploration and production of shale gas in Europe, under sustainable conditions, would allow Europe to reduce its external dependence and provides a new source of gas to the market.

■ Investment and electricity market design

Addressing the investment issue is of utmost importance to ensure future security of electricity supply. Capacity markets, properly designed, should allow a recovery of investment in gas capacity, and in particular, to restart the numerous mothballed gas plants and unlock frozen CCGT projects.