



Joint IEA-IEF-OPEC Report

On the

Third Symposium on Gas and Coal Market Outlooks

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1. Executive summary: Key findings

- The entry in force of the UN Paris Agreement to limit global warming and the 2030 Agenda for Sustainable Development point at a new global consensus that energy security and growth must balance social, economic, and environmental goals. How this balance evolves across economies will influence gas and coal demand in the longer term.
- Abundant supplies set the tone in medium-term gas market outlooks, prompting consumers to demand of producers, greater flexibility in the formulation of price mechanisms and contract terms. The degree to which sellers respond to such calls may influence the timing of gas market rebalancing.
- Greater gas availability has reduced consumer appetite for long-term commitments, postponing investment in new upstream and infrastructure projects by producers. Lower gas prices and greater abundance shall, together with rising import dependency of consumers, raise new security of supply and demand issues.
- Gas demand growth in non-OECD countries may well surpass that of the OECD region by 2020. However, gas sector growth does not follow naturally from demographics or energy transition goals alone.
- Still gas is poised to win most market share compared to other sources. Government and industry measures to improve air quality in urban centers, and reduce emissions at a global level will help accelerate innovation and the deployment of low carbon technologies relative to current market realities.
- Lower gas prices help both producers and consumers to unlock the historic opportunity for increasing gas consumption, but governments and industry must work together to reduce price and infrastructure hurdles in economies where reliance on coal remains high.
- A key challenge for both governments and industry is to enhance the competitiveness, affordability, and public acceptance of natural gas, to avoid locking more carbon intensive and expensive technologies in world energy matrices for longer than market realities and agreed goals require.
- Since gas imports may be costlier than more readily available coal and competitive renewables, coal remains the core fuel in many growth economies. Leadership on new policies, and technologies to achieve higher thermal energy efficiency and reduce harmful emissions will lower thresholds to a healthier energy mix where gas stands to contribute to overall system resiliency.
- The rebalancing of global gas and coal markets largely depends on the success of stakeholders to create a more flexible and better performing energy sector, including through accelerating

coal to gas switching, establishing new price signals, the deployment of state of the art technology, and expansion into new market segments.

- Shaping a new and reliable market environment requires new government - industry alliances and greater energy market transparency. An enhanced producer - consumer dialogue focused on energy market security and pragmatic energy sector transitions can help to uncover opportunities and reduce risks as both producers and consumers gain firmer footholds in a more reliable and healthy energy future.

2. Introduction

The Third IEA-IEF-OPEC Symposium on Gas and Coal Markets Outlooks was jointly organised by the International Energy Agency (IEA), the International Energy Forum (IEF) and the Organization of the Petroleum Exporting Countries (OPEC), in response to the call from G20 Leaders at the Cannes November 2011 Summit for continued dialogue between producers and consumers on short-, medium- and long-term outlooks for oil, gas and coal. The symposium was opened by the Director of the IEA, Mr. Fatih Birol, the Head in charge of the Research Division of the Energy Studies Department of OPEC, Mr. Oswaldo Tapia and the Coordinator of Energy Data Transparency (JODI) of IEF, Mr. Fuad Al Zayer. All the three representatives emphasised in their opening remarks the importance of the exchange between the involved organisations, referring to the first and second symposium held respectively in 2012 and 2014.

This Symposium focused on the main developments and trends in the gas and coal markets and the new evolving dynamics between these two fuels. In the first two sessions, the gas and coal market outlooks were discussed. The gas session also focused on to what extent well-supplied markets are accelerating changes towards more flexible demand and supply patterns, including their impact on contract structures and pricing mechanisms. Session three focused on the competition between the two fuels in light of the implementation of the recently agreed UN Paris Agreement and Sustainable Development Agenda to 2030.

The Symposium, which was held under the Chatham House Rule, was structured to encourage participation of all attendees after each set of presentations. Throughout the Symposium, several topics were discussed connecting both natural gas and coal. A number of points were raised concerning the role of gas and coal in the evolution of the energy mix over the coming decades, such as on the:

- Important role that gas will play in the long term, as the only fossil fuel that is likely to see its share in the primary energy mix of the world grow;
- Well supplied coal and gas markets that is likely to lead to relatively low prices for both fuels up to the end of the decade;
- Increasing pressure on gas producers, as a result of new gas volumes coming online, that may well push more natural gas volumes into shorter-term arrangements and on to spot markets;
- Declining role of coal in the energy mix of OECD economies; though, in many Asian growth economies, coal remains to be the fuel of choice for new power generation;
- Expectation that coal continues to be cheaper than gas, and therefore, that coal-to-gas switching would be limited in many Asian countries in the years to come;

- Importance of Chinese developments on the global coal markets; and that policies in China will continue to shape coal markets;
- Rebalancing of global gas markets that will also depend on the rate of expansion in China and other developing Asian countries;
- Increasing competitiveness of renewables in relation to coal and gas;
- Need to introduce cleaner and less carbon intensive ways of using coal, taking into account that coal will remain a substantial fuel in the entire energy mix;
- Growing support for a low carbon future, in public opinion, and among investors and financiers after the Paris Agreement entered force that is likely to eventually lead to stricter climate change policies and regulations.

3. Session 1: Gas market development in the short-, medium-, and long-term

In the first session on gas market developments, several new trends and projections were presented and discussed. IEA assessments showed that in the medium-term, the largest share of gas demand growth worldwide will still be on the account of OECD-countries; Non-OECD countries will take the lead in natural gas demand growth after 2020.

Despite the slow growth of global gas demand in the medium term, global Liquefied Natural Gas (LNG) export capacity will increase sharply from 2015 to 2021, led by the US and Australia over the next five years. Due to more liquefaction capacity, more supply and low prices, the pressure on producers to offer more volumes into shorter-term arrangements and on spot markets will continue to increase. However, buyers still accept long-term contracts in exchange for increased flexibility on terms such as those regarding destination, off take and pricing mechanisms. LNG capacity out of service has doubled over the past five years to 15%. Taking these outages into account with new capacity additions, LNG liquefaction plants will run at relatively low utilization rates around 2018. After 2018 the utilization rate will recover because LNG demand is then likely to increase. The current wave of new production additions is expected to recede by the early 2020s.

New small importing countries have entered the LNG market leading to new strategic questions for LNG producers and traders. LNG imports of Japan and Korea are set to decline due to a return to nuclear and coal fired power generation. Whether LNG will be able to increase its market share in Europe is still a difficult question to answer. It depends on many factors which make the perspectives for LNG supplies in this continent, where gas trade is dominated by pipelines, uncertain.

The rebalancing of global markets will depend on the rate of expansion in China and other countries in developing Asia. Given the current low gas prices and market circumstances, uncertainty will lead to a reduction of new investments in new LNG projects. To avoid future market tightness, greater gas market transparency to stimulate timely investments will be needed.

Growing gas demand is partially explained by the significant increase of new LNG projects, led by the US and Australia. However, in the World Oil Outlook 2016, OPEC emphasised that despite the increase of gas use in countries such as China and India, the share of natural gas in the energy mix of these countries will be relatively low compared to the share of gas in the energy mix of the OECD, OPEC, and Eurasia region. On the supply side, OPEC and developing countries have also seen a rapid rise of their gas output. OPEC member countries, with large reserves, possess significant potential for production

and exports. Natural gas prices diverged during the first years of the unconventional gas boom but converged again following the build-up of a LNG supply overhang and the oil price fall in 2014.

Senior industry representatives focused on the question of who will invest in an oversupplied gas market and the current low-price environment? On one hand the current market context of a sustained downward pressure on gas prices should favour demand growth and therefore could stimulate investment in midstream and downstream gas infrastructures rather than upstream resources. On the other hand, however, the outlook for new investment coming forward is challenged by significant uncertainties related to the macroeconomic environment in which with China's effort to find a 'new normal' affects the macro-economic outlook of many emerging markets, as well as by the abundance of energy supply alternatives at ever more competitive prices. These factors, together with a significant growth of gas market liquidity, clearly reduce the appetite for long-term commitments on the demand side, and therefore, weaken the business case for new projects.

Concerning the LNG market there are positive expectations for demand growth and import infrastructure development, with annual growth rates above 6%. Projects involve a quite different risk profile than in the past, and require adaptation of industry players' strategies and business models. Many new importing markets present higher demand uncertainty, a lack of internal infrastructures to connect to inland demand centres, high sovereign or credit risk, and a much lower ability and/or willingness to pay on the part of end consumers.

In this uncertain environment, a growing share of new regasification capacity is found in off-shore solutions such as in Floating Storage and Regassification Units, and Floating Storage Units (FSRU/FSU), which require less upfront costs, lower financing requirements, and less time to enter into service. Many local permitting restrictions (environmental and others) for on-shore facilities are overcome with floating solutions. Around 100 billion cubic meters (bcm) of new LNG import capacity (+9% of current global capacity) is expected to be developed using floating solutions between 2017-2020, especially in South East Asia and the Middle East.

Looking ahead, a key issue for the industry will be to reduce supply costs to enhance the competitiveness and affordability of natural gas. Otherwise, and at a very delicate time on the road towards the energy transition, LNG from new liquefaction projects could be priced "out of the market" and lead to a longer lock in of coal in world energy matrices.

Currently natural gas and LNG are premium fuels. The consolidation of gas demand growth in emerging and new market segments, will depend on its relative cost with respect to alternative fuels, and whether it satisfies security and health concerns of both governments and consumers.

During the roundtable discussion, several opinions were given by Symposium participants on new LNG business models, namely relating to the:

- Gas supply situation over the coming years that will see a substantial shift from creditworthy large base-load LNG importers, to less creditworthy importers, low demand and more price sensitive LNG importers;
- Current low-price environment, in which commercial risk becomes higher and cooperation between companies and standardization in construction and implementation becomes more important while investment prioritises expansion of low cost projects;

- LNG suppliers that have to be inventive to catch up to current market conditions, and in which floating solutions promise to ease cost and regulatory burdens;
- Further removal of destination clauses in LNG contracts that will allow balancing the over-contracted position of some players and free up LNG for new upcoming markets.
- Important instrument that destination flexibility offers to meet new demand particularly in region that are exposed to energy supply shortages;
- Conditions for investments in gas infrastructure that are quite challenging in Europe but different in Asian markets because gas demand is increasing due to energy demand growth in the region.

Improved energy market transparency is on one hand critical to overcome the challenges that gas markets are faced with today, while on the other hand it enables energy market stakeholders to capitalise with greater ease and efficiency on future business opportunities for achieving a more secure and healthy energy mix. Symposium participants took note of the work of the IEF on the Joint Organisations Data Initiative (JODI) carried out in close collaboration with the JODI partner organisations (APEC, Eurostat, GECF, IEA, OLADE, OPEC, UN). In the JODI 5-year action plan toward 2020, JODI plans to increase transparency of the oil and gas sector by improving data reliability, building capacity and engagement with the JODI user community, and promoting JODI brand awareness. Particularly concerning JODI-Gas, JODI plans to improve gas data reporting units, data completeness and data user feedback. Symposium participants took note of some of the findings of the JODI Gas World Database that illustrate the detailed and updated information the JODI database offers.

Delegates also considered the consequences for global gas trading in a looser market. According to private sector experts, the fall of oil prices since 2014 has caused a 'premature' gas price convergence between distinct regional markets. Though the global liquefaction surge has already started, the LNG off take market is not yet as liquid production volumes require. Small importers, while individually of marginal significance cumulatively contribute to huge demand growth. In three years, small importers have added 24 million metric tonnes per annum (mmtpa) of demand. 23 small LNG importers, excluding Europe, North America and core Asia, have grown their share of the market from 7% to 19% between 2008 and 2016.

In a world of diversifying energy demand in which demand forecasts appear as increasingly uncertain, Symposium participants questioned if new counterparties introduce a new credit or other risks and how this could impact the market. New frontier-market projects might well introduce indirect oil-gas price linkages and new importers could change relationship management and corporate governance dynamics as well as affect flexibility in the market.

During a second roundtable discussion, the following observations were made by participants regarding:

- The competitiveness of gas against oil: A great incentive exists to switch from oil-fired generation to gas-fired generation also if oil prices recover when supply and demand rebalance but gas prices stay low due to more persistent loose market conditions. In electricity generation, fuel switching from coal to gas could occur with greater ease as a consequence of regulation and when gas is more competitively priced than coal.

- LNG import countries taking advantage of low gas prices: LNG buyers want more flexibility to deal with demand uncertainty. In the present more competitive market conditions, sellers are well positioned to pursue strategies that place a value on added flexibility.
- Shipping; a crucial determinant of flexibility in LNG markets is the availability of ships to meet destination diversity in addition to the tonnage available in LNG vessels to meet increasing LNG trade flows.
- The volume of US LNG exports to Europe that depends on the price spread between US- and European hubs. From the point of view of the shipping distance, US LNG could well viably reach European, Latin America and Asian countries,
- Gas market data quality; not only the collection of reported information but also the ongoing monitoring of data is important to improve gas market data transparency. Data collection may be difficult depending on statistical capacity, regulations, and market restructuring.

Session 2: Coal market development in the short-, medium-, and long-term

The second session of the symposium covered the recent market developments in the coal sector together with the short-, medium-, and long-term outlooks.

IEA analysis showed how coal demand declined in 2015 for the first time in this century. There is a clear movement in global demand towards Asia which today represents three quarters of total consumption. North America and Europe used to account for 50% of total demand 15 years ago but today represents less than 25%. Significant production increases were witnessed in India, Australia and Russia. These however, were largely counterbalanced by production decreasing in China and the US during 2015. Chinese domestic coal production restrictions, led to an unexpected surge in coal prices during 2016 that was exacerbated by disruptions in Australia and Indonesia. Chinese Coal demand and GDP are less correlated compared to historic data; energy efficiency gains, power sector diversification, and the rebalancing of the economy towards services and domestic consumption away from reliance on export infrastructure are important new drivers.

Air pollution and the Paris Agreement figured prominently in the discussions among Symposium participants. Investments in the coal sector will have to be more selective and rely on advanced technologies. The impact of stronger emission reduction policies can already be observed especially in Europe where consumer perception is changing. The impact of more stringent emission reduction standards is likely to gradually increase over the longer-term depending on how policy discipline evolves in key energy consuming and producing countries.

Interconnected carbon markets, emission credit transfers and cooperative approaches ease implementation of Nationally Determined Contributions” (NDCs), but also help to support sustainable development. These could include carbon market clubs. By 2017, up to 22% of global Greenhouse Gas (GHG) emissions might be covered by carbon controls.

Progress in Carbon Capture and Storage (CCS) is quite limited so far but the use of CO₂ in Enhanced Oil Recovery (EOR) seems to be a promising option for pathways to a low carbon future.

In most Asian countries, high efficiency and low emission coal power plants, combined with renewables seem to be the current least cost strategy. The relatively low gas-, and high coal prices have not yet resulted in greater gas fired power plant investment. Security of supply considerations, in combination

with poor gas infrastructure still present market hurdles although floating solutions and LNG can help overcome these, provided they remain affordable.

The outlook for the coal market in the short to medium-term is characterised by global stabilization of demand in line with China's market restructuring where current coal demand declines are likely to be offset by a recovery in coal consumption by 2021. Cost reductions, sluggish demand and structural oversupply in China will continue to weigh down on coal prices. Meanwhile, in the long run demand is expected to increase slightly towards 2040, (especially in Non-OECD countries) although coal's share in primary energy mix it is expected to decline losing ground to gas and renewables over the next two and a half decades.

Participants were interested in the future prospects of coal in Africa. In addition to efforts to reduce energy poverty, demographic trends necessitate the establishment of new cities and expanding urbanization around existing ones. New infrastructure such as roads and airports will be built with cement and steel, and therefore undoubtedly stimulate coal demand.

Delegates also exchanged views about how differently coal and gas compete in distinct regional markets across the globe. Participants also shared perspectives about the future sustainability of the coal sector. Export capacity is much more concentrated in just a limited number of mining companies. A period of sustained low prices could lead to more business closures and greater industry concentration. New investments in production capacity was also carefully considered in this session's discussion. Colombia, one of the most competitive producers, could bring additional capacity on line if so needed with relative ease participants noted.

Finally, the outlook for the coal business was very pessimistic when carbon prices were introduced. Surprisingly coal demand has increased recently. Participants highlighted that the Paris Agreement recent entry into force and further extreme weather events could accelerate the adoption of stronger policies to further curtail GHG emissions, alongside changing public opinion on the urban and global environment.

4. Session 3: Gas and coal competition from a long-term sustainability perspective

Discussions in the third session commenced by focusing on the role of Clean Coal Technology (CCT). Coal, although a low-cost fuel and stable energy resource that continues to enable economic growth in many parts of the world, emits more CO₂ and other air pollutants than other energy sources do. Therefore, making coal consumption in power plants cleaner through advanced technologies is key to a healthier energy future. The need for clean coal technologies is all the more pressing as coal is widely expected to remain the main source for electricity generation – especially in India and Southeast Asia – against the background of an increasing electricity demand.

A comparison of 2013 data of India, U.S., China and Japan shows that the CO₂ reduction potential of existing coal-fired power plants in relation to Ultra Super Critical (USC) power plants is relatively low in Japan (~ 30 MT CO₂), compared to India (~230 MT CO₂), U.S. (~290 MT CO₂) and China (~655 MT CO₂). Hence, Japan could provide support for other countries to introduce clean coal technology through a range of measures (e.g. Human Resource development of relevant staff in relation to CCT, financial support and other).

Participants took note of the outlook over the next 2-3 decades for increasing the CO₂ reduction potential of new coal-related and gas-related power plant technologies compared to USCs (up to 30% CO₂ reduction) and Combined Cycle Gas Turbine (CCGT) respectively (up to 20% CO₂ reduction). However, apart from improving thermal efficiency, CCT need to be commercialised at greater speed in order to balance energy supply security with environmental issues.

Based on the latest World Energy Outlook 2016, Symposium participants considered IEA's views coal and gas market outlooks up to 2040. In light of the changes occurring in global primary energy demand, low-carbon sources will grow much faster in the next 25 years compared to the period between 1990 and 2015. Whereas natural gas will be the only fossil fuel with small increases in market share, coal and oil are expected to significantly lose market share. China's transition away from energy intensive industries, in particular cement and steel, will have major impacts on global energy market trends too.

A comparison of levelised costs for coal and gas in the power sector in different regions by 2025 has the following implications: New CCGTs is more competitive than new coal plants in all utilisation categories (peak-load, mid-load and baseload) in the United States and in the European Union (except for utilization levels larger than 75%), whereas in Asia investment in new gas plants is only profitable in mid- and peak-load operation modes. For existing power plants, coal-based power production in Asia as well as in the European Union is cheaper compared to gas in all utilization levels. The levelised costs of coal and gas plants converge only in the United States, that show a slight advantage for gas in mid- and baseload production modes dependent on fuel price projections.

The energy sector is the single most important source of GHG emissions and main pollutants (Nitrogen Dioxide (NO_x), Sulphur Dioxide (SO_x) and fine particulate matter (PM)) This provides an opportunity for natural gas to grow its share relative to coal and oil as the cleaner burning fossil fuel. Concerning PM, incomplete combustion of biomass is the single most pollutant, rather than coal or oil. Alongside reducing CO₂ emissions, actions to reduce methane emissions (not only an issue for the oil and gas sector but as well as for agriculture) present major opportunities to tackle near-term warming.

The outlook for renewable energy sources projects that they are increasingly competitive compared to gas and coal – adding CO₂ costs will only increase competitiveness of gas towards coal. However, huge efforts will have to be made in order to reduce CO₂ emissions and limit a global temperature warming to 2 degrees Celsius compared to preindustrial levels participants noted. In such scenarios, only the consumption of natural gas is expected to have higher market share and absolute level of consumption than today – while coal and oil consumption may well peak over the next decades.

Delegates also considered the perspectives offered by the Gas Exporting Countries Forum Secretariat that project energy demand to rise over the medium- and long-term. 75% of the global energy mix will be met by fossil fuels. The share of natural gas in the global energy mix shall rise to 40% markedly higher than IEA and OPEC outlooks project, taking advantage of a decrease in coal consumption. Non-hydro renewables account for almost 30% of additional primary energy demand. Over the outlook period until 2040, fuel input into power generation grows at 1.6 % per annum, an important sector where natural gas can be further promoted. A regional breakdown shows that natural gas approaches oil consumption as the dominant fuel by the end of the outlook period, whereas in non-OECD, gas remains the third most-consumed fuel behind coal and oil. In all countries, the gas industry will require significant investments in order to deliver new gas to domestic and to export markets, of which the upstream part will take the largest share with more than 90% of total investment.

Points discussed between the participants and the speakers included health consequences in connection with air pollution due to primary energy use and an update on nuclear power plants in Japan. Further questions were raised on the importance of maintaining contractual relationships between buyers and sellers and if major gas producers are considering defending market share also by delivering more quantities in the trading market. With respect to contractual relationships, it was pointed out large monopolies can still be flexible negotiators and well capable to adjust contracts in order to deliver the quantities needed for the relevant markets. Participants also noted a higher price for CO₂ emissions as the most important tool to further advance the use of natural gas in the interest of a more sustainable energy future. Participants also took note of the World Energy Outlook Special Report 2016 on Energy and Air Pollution that estimated premature deaths at about 6.5 million per year, of which about 50% are caused by the burn of biomass alone.

5. Conclusion

Symposium participants encouraged IEA, IEF and OPEC to further strengthen their co-operation. Deepening understanding of coal and gas market interactions and energy market developments in general has become more important for achieving a more secure and healthier energy future. Perspectives on market dynamics should therefore be openly exchanged and informed by complete, timely and robust energy market data as JODI Partner Organisations ensure.

IEA, IEF and OPEC will continue to contribute to enhancing understanding of the different dynamics in these energy and technology markets, as well as of the different priorities and interest viewed through government, industry, as well as producer and consumer country perspectives. The three organisations expressed their ongoing commitment to the trilateral work programme and the collaboration they pursue in this important framework for energy dialogue among senior energy experts.

The symposium recommended to continue discussions on the need to introduce more clean coal technologies, assessments of the present supply situation on global gas markets in light of the growing role of small LNG importers and noted that gas is likely to play a key role in the global energy mix as the least carbon intensive fossil fuel, that can offer the flexibility energy markets need in order to accommodate higher level of renewables.