

EFFECT OF NATURAL GAS USAGE ON ENVIRONMENT – AN ARTICLE

Amitabh Ranjan¹

Natural Gas and World

Natural gas is a new age fuel and believed by many to be the most important energy source for the future. Over the years, Natural gas has established itself as a dominant and reliable fuel source across the world due to its availability, advantage as cleaner fuel and multiple applications. Natural gas is the only fossil fuel whose share in the primary energy mix is expected to grow in future. Today, natural gas accounts for over 24% of the energy used worldwide, and makes up nearly a third of electricity generation, as well as playing a crucial role as an industry feedstock. With emergence of shale gas and the rising supplies of liquefied natural gas (LNG), natural gas market has become more globalized. This evolution of natural gas in the global energy mix has made significant consequences on global energy trade, air quality and carbon emissions, as well as the security of global energy supplies. In coming days, it is envisaged that gas will grow faster than oil and coal, helped by low prices, ample supply, and its role in reducing air pollution and other emissions.

By energy source, natural gas accounts for the largest increase in world primary energy consumption in recent years. In 2016, primary energy consumption grew by just 1% (171 mtoe²), almost half the average rate seen over the previous 10 years where as natural gas consumption increased by 1.5%. Most of this growth comes from increasing global LNG trade which is expanding by 4-6% per year, compared to around 1-2% for overall gas consumption.

Traditionally, natural gas supply was limited to a few producer countries including Russia, Qatar, Iran, Norway, Algeria, Indonesia, Malaysia etc. But of late, global natural gas market is evolving rapidly under pressure from two driving forces: the shale revolution, led by the USA, and the LNG revolution which is testing traditional gas business and pricing models. USA has been the world's top producer of natural gas since 2009, when US natural gas production surpassed that of Russia. In 2016, USA has produced around 749 BCM of natural gas where as Russia produced around 579 BCM of gas. Other leading producers of natural gas globally in 2016 include Iran (202 BCM), Qatar (181 BCM), Canada (152 BCM), China (138 BCM), Norway (117 BCM), Saudi Arabia (109 BCM), Algeria (91 BCM), Australia (91 BCM) and Malaysia (74 BCM). India remained far behind in terms of the production with a production of 27.6 BCM in 2016. Heavily oversupplied markets, thanks to the ongoing shale-gas revolution in the United States, the second wave of additional liquefaction capacity from Australia and the USA, and the fast-growing LNG trade have changed global gas market

¹ DGM, Deptt of Strategic Planning and Advocacy, GAIL, Noida India

² Mtoe = Million Tonnes of Oil Equivalent, BCM = Billion Cubic Metres

dynamics. This has forced market players to redefine their strategies and explore new markets.

On demand side, gas still primarily consumed where it is produced. However the gas market has become increasingly interconnected through both cross-border pipelines and increasing LNG volumes, mostly in emerging markets. Apart from traditional LNG importers like Japan and Korea, there is increasingly growing demand from emerging economies including China, India etc. In 2016, US remained the largest consumers of natural gas with 779 BCM followed by Russia (390 BCM), China (210 BCM), Iran (200 BCM), Japan (111 BCM) and Saudi Arabia (109 BCM). Many other countries are also reforming their gas markets to increase the use of gas and to attract new investments in natural gas market. Gas currently represents 30% of total fossil-fuel consumption in the power generation sector, while coal and oil products represent 62% and 7%, respectively. However industrial sector has slowly overtaken the power sector in recent time as the leading user of gas, thanks to rising demand in places like the China, developing Asia, the Middle East and the United States. Gas consumption in India has reached 50.1 BCM in 2016 where demand has mostly come from power, fertilizer and industrial sector including CGD. Due to lack of domestic production, like many other countries India is forced to rely on the imported gas to meet its demand. In coming years, China, India, and South East Asia is expected to see the strongest demand growth on the back of continued strong economic growth, increased concerns about air quality, and growth in the industrial sector.

Challenges

Currently, the biggest challenge faced by the natural gas market is the weak growth. The shifting dynamics in natural gas pricing in recent years can be attributed to regional supply and demand imbalances. In many importing nations, the economic risks of import dependency and exposure to volatile commodity prices have make gas a less attractive fuel source. The oil price collapse, which began in June 2014, has triggered a wave of cost reduction among upstream businesses including natural gas sector. Almost all global oil and gas companies slashed their capital expenditures by about 40% between 2014 and 2016. This descending gas price has also made many upstream LNG projects unviable. As further supplies are coming to the market, it appears likely that the current market oversupply and low price environment will continue in the short to medium-term.

But despite of all the challenges, future of natural gas looks very promising in coming years and it is expected that natural gas will remain as the favorite source of primary energy. As a result of gas-to-gas pricing competition, emergence of short-term trade and increasingly strong consumer bargaining power, gas has found new markets and gas markets has become gradually interconnected. With commercial availability of new technology to access new unconventional sources economically, the supply is going to be multiplied in near future and natural gas will remain as a cheap and practical short term alternative until long term solutions are found and 100% clean energy targets are reached.

Environmental Benefits of Natural Gas

The demand for energy is expected to increase in near future as global population will increase. The world of energy will undergo a major transition where Natural gas will play an important role together with renewable energy sources and storage technologies. Natural Gas is widely recognized as a relatively low-carbon, cost-effective fuel. Use of Natural gas can help to meet CO₂-reduction goals as well as reduce unhealthy emissions such as NO_x, SO_x and particulates.

Natural Gas can play a very important role in the energy transition by reducing emissions and replacing more carbon intensive coal. Natural gas is an energy source that can act to balance a growing renewables sector. Natural Gas in combination with renewables can provide energy for society with much lower carbon footprint as compared to coal.

Natural gas, the cleanest fossil fuel, is a highly efficient form of energy. It is mainly composed of methane (CH₄). When methane is burned completely, the principal products of combustion are carbon dioxide and water vapor. Natural gas has fewer impurities, it is less chemically complex, and its combustion generally results in less pollution. Upon combustion Natural gas produces significantly less pollutant emission e.g. CO₂, SO_x & PM as compared to oil or coal, which adversely affect health. Because natural gas burns cleanly, it doesn't leave behind any unpleasant soot, ash, or odors. Natural gas is also non-toxic. If inhaled in small amounts natural gas is not poisonous or harmful to humans. Burning natural gas produces nitrogen oxides (NO_x), which are precursors to smog, but at lower levels than gasoline and diesel used for motor vehicles. DOE analyses indicate that for every 10,000 U.S. homes powered with natural gas, instead of coal, avoids the annual emissions of 1,900 tons of NO_x, 3,900 tons of SO₂, and 5,200 tons of particulates. Reductions in these emissions translate into public health benefits, as these pollutants have been linked with problems such as asthma, bronchitis, lung cancer, and heart disease.

Natural gas has a current price advantage over diesel and Petrol. Natural gas vehicles emit up to 80 percent less particulate matter, an especially problematic pollutant from diesel exhaust that causes asthma, other lung ailments, and premature death. Carbon monoxide emissions can be reduced 20-40 percent and volatile organic compounds (VOCs) by 10 percent. Further, the use of natural gas as a vehicular fuel provides environmental benefits. Greenhouse gas emissions are reduced on a total lifecycle or well-to-wheels basis by 15% to 25% below diesel vehicles.

Natural gas is convenient. The energy source is piped directly to the customer's facility through the safe, efficient pipeline system. There's no need to store oil on site in tanks, or schedule oil deliveries. Switching to natural gas eliminates the need for a storage tank--eliminating the threat of oil spills, soil contamination and costly environmental clean-up. Natural gas use does not pose any risk to soil or groundwater because it is lighter than air and will rise into the atmosphere if released.

Natural Gas helping to Combat Climate Change

India's economic success in recent years has helped to ensure that South Asia is the fastest-growing region in the world and it is projected to grow at 6.7%, according to OECD³. India is the world's seventh-largest economy, sitting between France and Italy. By 2050, India's economy is projected to be the world's second-largest, behind only China. Even in terms of energy consumption India is third largest energy consumer in the world today. Energy use is vital for a modern economy. The demand for energy is bound to increase as economic development continues. It is projected by BP Energy Outlook 2017 that India's share of global energy consumption in 2035 shall be around 9%.⁴

The modern economy is powered largely by fossil fuels. Burning fossil fuels produces CO₂. The largest increase in global CO₂ emissions from energy use in 2015 came from India (5.3%) standing 3rd globally with 2218 MT CO₂ emissions.⁵ Climate change is primarily a problem of too much carbon dioxide (CO₂) in the atmosphere.⁶ Thus, confronting climate change depends, in many ways, on adopting new and sustainable energy strategies that can meet growing global energy needs while allowing for the stabilization of atmospheric CO₂ concentrations at safe levels. Climate change is an urgent problem requiring global action to reduce emissions of carbon dioxide (CO₂) and other greenhouse gases (GHGs).

Time has come that societies must not only use energy more efficiently, but also must emit much less CO₂ per unit of energy produced. The reduction of CO₂ emissions per unit of energy, an essential requirement of addressing climate change, is known as de-carbonization. De-carbonization can be achieved in two ways. The first is to use of less polluting fossil-fuel-based energy sources. The second is to adopt technologies that permit the use of fossil fuels while preventing the build-up of CO₂ in the atmosphere. In this article we put emphasis of the former option.

Natural gas is an abundant energy resource found in many regions of the world. The worldwide recoverable resources of natural gas are around 186 tcm, as per BP Statistical review. These reserves offer a safe, efficient and reliable energy source. Natural gas is the least carbon intensive fossil fuel; unlike other carbon-based fuels, natural gas has a high hydrogen/carbon ratio and therefore emits less carbon dioxide for a given quantity of energy consumed.

Facts and Figures⁷

³ <https://www.weforum.org/agenda/2017/10/eight-key-facts-about-indias-economy-in-2017/>

⁴ <https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/country-and-regional-insights/india-insights.html>

⁵ <https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>

⁶ http://www.ucsusa.org/global_warming/science_and_impacts/science/CO2-and-global-warming-faq.html#.WgkxjFWWbIU

⁷ Is Natural Gas Green Enough for the Environmental and Energy Policies?, IGU : 2012-2015 Triennium Work Report

- Natural gas is a cleaner burning fuel than coal or oil. When burned, it releases up to 50 percent less carbon dioxide (CO₂) than coal and 20-30 percent less than oil
- Vehicles powered by natural gas produce 20-30 percent fewer carbon dioxide emissions than vehicle powered by petrol
- Ongoing technology developments enabling the capture and sequestration of CO₂ (CCS) also supports the choice of natural gas
- The lower levels of carbon monoxide, volatile organic compounds, oxides of nitrogen, sulphur dioxide and particulate matter generated by the combustion of natural gas makes the continued and increasing use of this energy resource a significant contributor to improved local air quality

High Efficiency with Natural Gas

- Based on state of the art technologies, efficiencies of up to 60% can be achieved in electricity generation
- Natural gas based combined heat and power production achieves overall efficiencies of up to 90%
- Condensing boilers used for space heating can achieve efficiencies approaching 100%

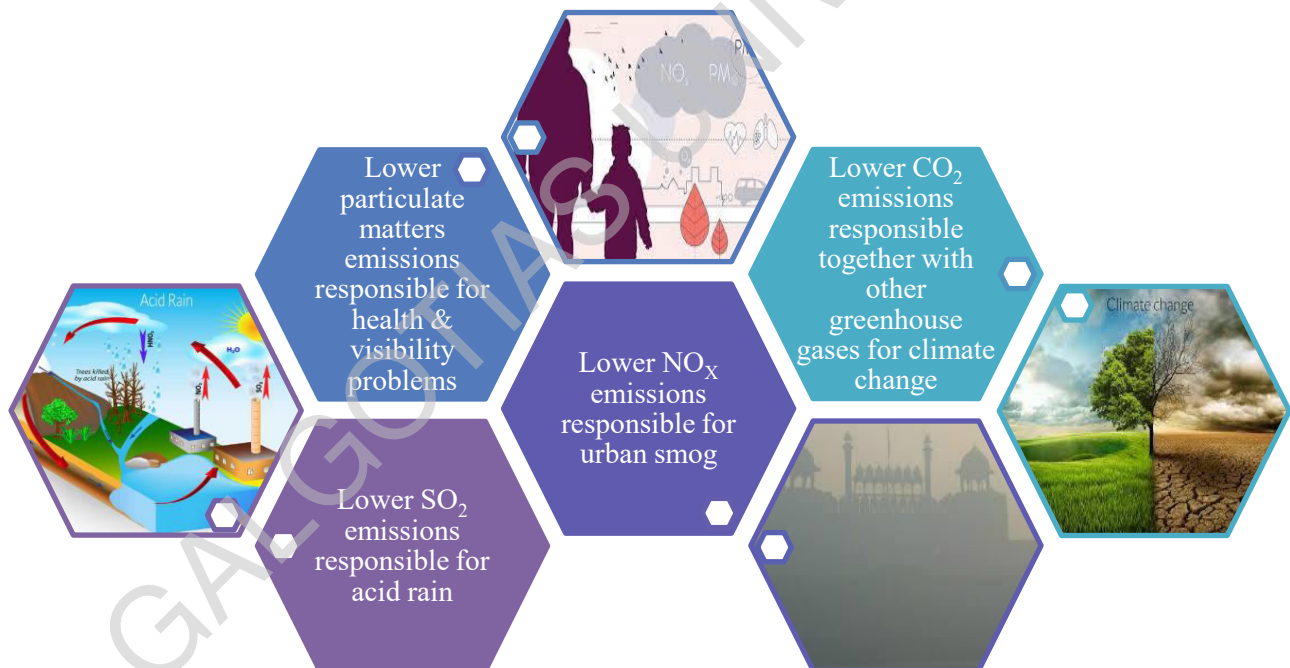


Figure 1: What Supports the “Clean” Image of Gas? ; Authors Compilation

Gas can reduce problems of poor air quality, e.g. smog and particulates, when used in power generation, as an industrial fuel and as a transportation fuel. While Compressed Natural Gas (CNG) is used in passenger and return-to-base commercial vehicles, Liquefied Natural Gas (LNG) also presents a cleaner alternative to the use of oil products for heavy-vehicle road and marine (inland) transport. The above properties of natural gas offer societal benefits in the

more environmentally friendly operation of energy systems, in presenting policy solutions that address local air quality issues, in energy conservation and efficiency, and in containing climate change and supporting the use of intermittent renewable energies.

Conclusion

To summarise the low-carbon property of natural gas, offers more energy per unit of CO₂ emitted than other fossil fuel. This is further emphasised by advanced technological developments, i.e. Combined Cycle Gas Turbines (CCGT) and Combined Heat and Power (CHP) plants, with thermal efficiencies of up to 60% and 80%, respectively. As a result, the amount of CO₂ emitted per kWh generated by CCGTs is about half of that from coal. Combatting climate change is one the biggest issues for policymakers worldwide. To limit global warming to 2°C, the world will have to reduce CO₂ emissions and convert rapidly to lower-carbon energy systems. Given the above facts the contribution that gas could make towards a low-carbon environment is substantial is thus an apt fossil fuel for combatting climate change.