

Coal and gas power – time to dispel myths

May 25, 2016, 8:31 pm



By Dr. Janaka Ratnasiri

Indian Prime Minister Narendra Modi is reported to have responded positively to a request made by President Maithripala Sirisena to get the proposed coal power plant at Sampur converted to a natural gas operated power plant (*The Island* of 17.05.2016). However, since then several parties have expressed concerns about costs, delays in getting power on line and global warming. Hence this write-up to dispel whatever myths people may have about coal and gas power.

Use of gas for electricity generation

During the first 2/3 of the last century, coal played the major role in generating electricity in both developed and developing countries and for that matter even thermal energy. However, with the development of the combined cycle gas turbine (CCGT) technology in the latter half of the century, natural gas became the favoured fuel for generating electricity. According to International Energy Agency (IEA) Statistics 2015, natural gas (NG) share of global electricity generation increased from 12% in 1973 to 22% in 2013; the balance share of 78% being met by coal (41%), hydro (16%), nuclear (11%), oil (4%) and renewable energy (6%). With the flexibility of NG fired CCGT power plants to be able to adjust for varying load conditions, these can be used not only to meet base loads but also peak loads, unlike coal plants which are meant to use only with base loads.

Why natural gas is favoured over coal?

NG is the favoured fuel because its combustion does not cause any pollution of the environment unlike coal, whose combustion leaves behind mountains of coal ash containing significant amounts of toxic heavy metals including mercury, arsenic, cadmium, chromium, nickel, lead, zinc as well as radionuclides. Coal combustion also causes emission of Sulphur Dioxide (SO₂), which is a source for acid rain affecting vegetation and structures, fine particulates matter (PM) causing respiratory ailments among people who breathe in air containing these particulates.

Among fossil fuels, coal emits the highest amount of Carbon Dioxide (CO₂) per unit energy generated, unlike NG which emits only about 50% of that emitted by a CPP. NG combustion leaves no ash or SO₂ or PM at all. Even the NO_x emitted is much less than that from a coal power plant (CPP).

Many countries are, therefore, switching from coal to NG for power generation as a measure to mitigate carbon emissions. The unlimited combustion of coal for over a century has been the primary cause for global warming and in turn climate change which has made nations, particular the poor the world over, at risk of so many adverse impacts. The whole world is now battling against this and the nations are now trying to keep the mean global temperature rise within 2oC by reducing carbon emissions and arrest the situation.

Although the responsibility for this was originally left in the hands of developed countries responsible for the calamity, the Paris Agreement on Climate Change entered into last November and signed by the countries last month, made every nation responsible for reducing carbon emissions in their own little way voluntarily. Hence, Sri Lanka, too, has a responsibility for controlling carbon emissions, at least not to allow it to grow when there are alternative low carbon emitting options available.

Is coal power cheap?

In Ceylon Electricity Board's Long Term Generation Expansion (LTGE) Plan 2015-34A, coal power is estimated to cost Rs. 9-10 per unit of electricity (kWh), the cheapest among several options. However, the performance of the Puttalam coal power plant (CPP) during 2014, as given in CEB's Statistical Digest (SD) 2014, tells a different story. The data on generation, fuel cost and consumption during the year give the cost of fuel per kWh as Rs. 6.32. With the data given in LTGE Plan on plant cost, interest during construction and discount rates, operation and maintenance, the total cost of generation from the Puttalam CPP works out to Rs. 15.98 – say Rs. 16 per unit, which is significantly higher than CEB's own estimate. This is without adding any cost of externalities including health damage cost which is estimated to be about Rs. 5.70 per unit for coal.

These prices are based on 2014 exchange rates. The exchange rate between USD and LKR has been increasing from 89.36 in 2001 to 130.56 in 2014, at an average annual rate of 3.03% (*CB AR 2014 Special Statistical Appendix*). Assuming the same rate will apply in the future as well, the rupee will depreciate to about LKR 210.50 per USD by 2030. This will make the future cost of coal electricity LKR 25 per unit, assuming all associated costs will increase at the same rate. The cost with the externalities added will increase to LKR 35 per unit. On the other hand, any domestic sources such as biomass or small wind turbines turned out locally could keep the price escalation within limits.

Natural gas power cheaper than coal power

Plant to plant, a NG power plant is much cheaper than a coal plant; about USD 1000/kW vs. USD 1500/kW; more advance plant costing double that amount. For an NG/CCGT plant, the data given in LTGE Plan give the annual plant cost per unit as Rs. 1.92 and operation and maintenance cost as Rs. 0.74 per unit. The gas has to be imported as liquefied natural gas

(LNG) for which a special terminal needs to be built to unload the LNG. The cost of LNG, according to a long term contract entered by India with Qatar last December, has been about USD 6-7 per million Btu. Some years back, Iran, too, offered natural gas to Sri Lanka on a government-to-government basis, and this could be revived since the sanctions against Iran have now been lifted.

Assuming Sri Lanka, too, could negotiate directly with Qatar government and obtain LNG at the same or better price, the cost of fuel per unit works out to Rs. 6.36 after adding the amortised cost of the LNG terminal into the cost of fuel. Hence, the total cost of generation of a unit of electricity from NG will be Rs. 9.02 per unit, which is far less than that from coal. Further, the cost of externalities for an NG plant will be only Rs. 1.07 per unit, which makes the cost with externalities to be Rs. 10.09, compared to 21.70 for a coal plant. Thus, the slogan that coal power is the cheapest is a myth!

Will the gas plant cause delay in getting power on line?

A CCGT plant comprises two components, the gas turbine (GT) and the steam turbine (ST) which gets its energy from the waste gas of the GT, thus increasing its efficiency to over 50%. Work on the GT could be completed in less than two years and the ST may take another year or so. On the other hand, the Puttalam CPP's first phase took five years to build and the rest another three years. Hence, out of the proposed 500 MW capacity, at least 330 MW of power could be generated within two years if work on both units (2x250 MW) are undertaken together, and the balance in another year. Although a new EIA will have to be done, it should be possible to complete a report without padding it with unnecessary stuff within a short period time as there is hardly any adverse environmental impacts from a NG plant.

If the CEB wishes to get power on the grid early, the best option is to shift the plant site from Sampur to Kerawalapitiya, where already a 300 MW CCGT plant is in operation and infrastructure available. The proposed 220 kV transmission line from Sampur to Veyangoda could then be done away with, saving money and time needed doing EIAs for that. According to LTGE Plan of CEB, the Colombo North Port has already been identified as a suitable site for building a LNG terminal. Once the liquefied gas is converted to gas at the terminal, gas could be taken to Kerawalapitiya via a sub-sea pipeline.

To put the project on a fast track, a floating LNG terminal could be leased initially to supply the gas and this could be berthed within the port until work on the land terminal is completed. Hence, any fears that converting to an LNG plant will cause delay in getting power into the grid is another myth that needs to be dispelled. With NG available in Colombo, it will be possible to convert the present oil operated 3 CCGT plants also to operate on NG, thus saving money on oil.

Will NG use enhance global warming?

Fears have been expressed that any gas leaked from the new system into the environment could add to the global warming (*Island* of 21.05.2016), because of high radiative forcing of

methane, principal constituent of NG, being about 21 times that of carbon dioxide over a 100 year time frame.

Yes, NG processes do cause fugitive emissions, but the savings from coal to NG conversion outweighs such emissions by several fold. A major source of methane released to the environment is coal mining itself, and it is reported that such emissions amount to about 7.2 gCO₂/MJ of coal mined while that emitted from NG processing is about 14.7 gCO₂/MJ of NG processed(www.capp.ca/~media/.../215278.pdf).

In the proposed Sampur CPP, the expected amount of coal consumption annually is 482 kt or 38.23 PJ, while the NG consumed once it is converted will be 23,910 GBtu or 25.23 PJ. The corresponding amounts of fugitive methane emitted will be 275 ktCO₂Eq and 371 ktCO₂Eq, respectively. Hence the net amount of methane emitted after avoiding emissions from coal mining will be 96 ktCO₂Eq. The anticipated CO₂ emissions from 500 MW CPP will be 3,615kt/y, while that from a 500 MW NG-fired CCGT plant will be 1,415 kt/y, resulting in a saving of 2,200 kt/y from fuel conversion. After accounting for fugitive emissions which is less than 4.4%, there will be a net saving of about 2,100 kt of CO₂ annually.

How safe is natural gas use?

NG is a hydrocarbon like petrol and LPG, but is safer than both of them. With LPG, there have been many casualties reported resulting from fires caused by leaking domestic LPG cylinders. LPG being heavier than air accumulates near ground when a leak occurs causing explosions, whereas in the case of NG, any gas leaked will get dispersed being lighter than air. An NG-air mixture will cause an explosion only if the gas concentration rises above 4-5%, but the odorant added to the gas will alert the consumer by emitting a distinct odor long before such a level is reached.

During more than a half a century of NG and LNG use, there have been only a very few accidents and even those mainly due to human errors. The entire NG industry is governed by strict safety protocols and standards, and the operations at all levels including international transport, national transmission and local distribution have to be carried out by licensed operators who are well trained to handle any emergency situation. It is essential to establish an authority locally to implement standards and regulate the industry. It will be then possible to guarantee the safety of both consumers and plant operators against any misadventures.

Environmental impacts of coal power

Though the Puttalam CPP has been in operation for several years now, no proper assessment of its impact on the environment as well as on the health of people living in the area has been carried out by any responsible party. The plant has affected the livelihoods of both fishermen and farmers. The extent to which the power plant has affected the lives of fishermen in the area can be found out by speaking to the fishermen themselves. I myself with a few others visited the area recently and spoke to them and they said that they no longer could do any fishing in the area because fish were driven away due to both warm water discharged from the plant and spillage of coal while being transported along

the conveyor belt during unloading from the barge. Now, they have to fish in deeper waters, but they do not have suitable boats.

During our visit, we met some farmers who cultivate various crops on land close to the power plant and they said that when wind blew from the sea towards inland, coal dust got carried far into their land. When they complained, they had been given some compensation once. Certainly, a body like CEB should take prompt action to prevent coal dust getting blown without waiting for someone to take them to courts or paying some money to keep people silent. Though the EIA report has recommended that a belt of tall trees be planted along the perimeter to prevent coal dust from getting blown into farm land, we did not see a single such tree in the area.

Even the Central Environmental Authority and the Environmental Authority of the North Western Province or the Coast Conservation and Development Department, the project approving authority are turning a blind eye to the pollution caused by the coal plant, shirking their responsibility. Also, no one seems to be monitoring pollution emissions from the plant or their concentration levels in ambient air around the plant or at least such findings, if any, have not been made public, as required by the EIA. The myth that Puttalam plant has not caused any adverse impacts on the environment is another that needs to be dispelled.

When the rest of Asia is using coal why not Sri Lanka?

A number of developing countries in Asia including China and India are building or planning to build new coal power plants in the near future, but there is pressure for them not to proceed with those plans. According to Platts Energy, China is planning 150GW of new coal plants by 2020. India, though it has declared ambitious plans for solar power, plans to increase its share of coal by 125GW. Simply because other countries in the region are building more CPPs that does not necessarily mean that Sri Lanka should follow suit. We have to safeguard the health of our own people and avoid degradation of our environment. Sri Lanka should aim to be better than the best when it comes to energy choices and not better than the worst polluters, India and China.

The international community is concerned about these plans, as expressed by the President of the World Bank; he recently said that "plans to build more coal-fired power plants in Asia would be a "disaster for the planet" and overwhelm the deal forged at Paris to fight climate change". The World Bank will be holding a two-day meeting in November to address the issue of putting coal-fired plants on hold – permanently – and making it affordable and practical for developing countries now dependent on coal and oil to replace these fossil fuels with clean sources of energy such as wind and solar.<<http://www.theguardian.com/environment/2016/may/05/climate-change-coal-power-asia-world-bank-disaster>>.

Situation in western countries

Under the Climate Change Convention negotiations, almost all of developed countries are planning to phase out their coal power plants and go for natural gas power and

renewables. According to the US Energy Information Administration publication "The Annual Energy Outlook 2015", USA's coal share of total electricity generation, which was 50% in 2005 and 33% in 2015, is expected to fall to 21% in 2030 and to 18% in 2040. The US may be building more CPPs, but is retiring most of its aged low efficient subcritical plants. The report also says that "Natural gas generation increases by 44% under the new policy of adopting clean energy and by 32% in the business-as-usual from 2015 to 2040".

The IEA World Energy Outlook Special Report 2016, says with respect to European Union, that "renewables will account for more than half of the European Union's power generation capacity in 2030 under Paris Agreement Scenario, and that coal-fired capacity will decline by nearly 40%, to stand at around 120 GW, while gas-fired capacity will increase by one-third, to reach 300 GW. According to *Popular Science* website, UK will be phasing out all its coal power plants by 2025 and go for natural gas power. Chancellor of Germany, Angela Merkel, has established national targets to get 35% of its electricity from renewables by 2020, and 80% by 2050 and as a result will be closing down its coal power plants.

Place of renewables

With abundant supplies of wind power, solar and biomass available in the country, it will be possible to replace all of fossil fuels with RE sources altogether, not only for electricity generation but also for meeting energy requirements for transport and industries, commercial and domestic sectors, but it will take some time. Technology for utilizing RE sources efficiently in these sectors is already available, but their transfer for local applications is not ready yet, for which the private sector has to take the initiative.

The costs of these RE sources as well as storage devices are declining yearly and will become cost-effective not too far in the future. In the event they are going to be costly, Sri Lanka could seek funding offered under the Paris Agreement to defray the additional incremental costs associated with RE sources. But it needs professionals with vision, common sense and rational thinking with an open mind as well as decisionmakers having the will and national interest foremost in their minds. Fortunately, political will appears to be in place but the politicians alone cannot deliver the goods. The professionals in the sector need to come forward to make it happen.