Since winning the war, according to media reports, persons in both the public and private sectors have been talking about converting Sri Lanka into various hubs in such sectors as business, aviation, shipping, energy etc. Yes, Sri Lanka does have the potential to serve as an energy hub to serve the needs of both the South Asian region and the country's. For this purpose, the availability of Trincomalee harbour, a gift of nature given to Sri Lanka, needs to be exploited. A moderate size natural gas terminal built at Trincomalee could serve this purpose.

## Natural gas – the preferred source of energy

As a primary source of energy, countries world over are shifting to natural gas because of its many environmental benefits compared to those of coal. Natural gas (NG) does not emit any fly ash containing fine particulates, or any bottom ash containing hazardous substances, or any sulphur dioxide like other fossil fuels. For example, a 300 MW coal power plant generates daily about 250 tonnes of fly ash and about 60 tonnes of bottom ash. Though filters remove about 98-99% of the particulates from fly ash, the balance 2.5-5 tonnes are released into the atmosphere. However, with time, this amount could even increase. These very fine particulates cause much damage to the vegetation and health of the people living in the area where these ash settle down. Coal dust released during unloading is another hazard. With a NG fired power plant, there is absolutely no emission of any particulates or any SO2 emissions. Also, the amount of NOx emitted is also very much less.

The NG power plants have both local and global benefits. While the hazardous pollutants emitted and coal dust spread by a coal power plant are totally absent in NG power plants, the amount of CO2 emitted which cause global warming is also much less in NG plants, being only about 40% of what a coal power plant of similar capacity emits. Hence, many countries are shifting to NG as a source of clean energy and also to reduce carbon dioxide emissions and comply with the requirements of UN Framework Convention on Climate Change (UNFCCC).

## Benefits to Sri Lanka in using natural gas

According to Ministry of Power and Energy website, the Ministry has decided to build a 1000 MW coal power plant at Sampur near Trincomalee as a joint venture with India. The website further says that it plans to build a second 1000 MW coal power plant at Muttur. If natural gas becomes available at Trincomalee, it will not be necessary to build coal power plants which would cause heavy pollution to water, land and air. Instead, natural gas-fired two combined cycle gas turbine (CCGT) power plants of same capacity could be built there at much less cost and in less time. It will totally eliminate pollution associated with coal power plants. Three CCGT plants are already in operation at Kelanitissa and Kerawalapitiya and they are known for their high efficiency.

There are other benefits the country would accrue by shifting to natural gas from coal to generate electricity. The carbon foot print of industries supplied with electricity generated from natural gas will be much lower than that when using coal-generated electricity. This will enable them to have a competitive edge over industries in other countries in selling their goods overseas. Also, Sri Lanka plans to get more tourists to the country in the coming years, and having a pollution free environment will certainly enable the country to achieve this target.

The third is the possibility to comply with the Copenhagen Accord targets. In the recently concluded Climate Change Conference at Copenhagen, Parties were required to report what voluntary measures they would take in order to mitigate greenhouse gas emissions. For a country like Sri Lanka, where the current level of emissions is at a minimum, there is no possibility of reducing emissions further. What we could do is to reduce future emissions and show it as a reduction relative to future business-as-usual (BAU) scenario. This is a topic that would come up at the UNFCCC meeting being held this week in Bonn.

If the two proposed coal power plants of capacity 1000 MW are operated till 2020 under business-as-usual (BAU) scenario, and under mitigated case if each is replaced by a similar capacity gas-fired CCGT plant, and the existing CCGT plants are also run with NG, the CO2 emissions alone could be reduced from about 26 million tonnes (Mt) to about 18 Mt by 2020. This is a 30 % reduction relative to BAU case, which is quite significant. It is assumed that thermal power of total capacity 4,500 MW will be in operation by 2020. Currently, Sri Lanka emits nearly 6 Mt of CO2 annually from thermal power plants.

## Global utilization and transport of Natural Gas

In 2007, electricity was generated globally 21% from natural gas, 41% from coal, 14% from nuclear energy, 16% from hydro power, 6% from oil and 2% from other sources (Int. Energy Agency, 2009). However, electricity generation is not the only use of natural gas. It could be used as a feedstock in many chemical industries including the manufacture of urea. It is also used widely as a source of thermal energy in industries and for space heating during winter months in temperate countries as well as for cooking. The natural gas share of total primary energy source globally is 24%, while coal, oil and nuclear power contribute 21%, 37% and 11%, respectively (IEA, 2009).

In North America and Europe where NG is widely used, NG is transported in pipelines laid across borders. Across oceans, the gas transported in purposely built carriers in liquefied form when its volume gets reduced to a fraction of 1/600. However, special deep jetties (minimum 16 m depth) are required to berth LNG carriers and transfer the LNG to storage tanks built on-shore. From there it is re-gasified and distributed to users. Currently, Japan and Korea are the largest importers of LNG in Asia, the volumes imported annually being about 84 Billion cubic metres (Bcm) and 36 Bcm, respectively, and these come mainly from the Middle East and Australia.

The construction of LNG terminals is an expensive exercise, costing of the order of US$ 300-400 million for a small terminal with capacity of about 1.5 million tonnes per year (Mtpy), the

minimum viable size sufficient to feed a 1,500 MW power plant. The high end cost could be as much as US$ 1,000 million for a 5 Mtpy terminal. The cost could be reduced drastically if a deep harbour is already available with adequate space to construct the necessary infrastructure. Generally, higher the throughput, cheaper is the terminal operation.

## Proposals for the import of LNG to Sri Lanka

During the last decade, several proposals – both solicited and unsolicited - have been submitted to authorities in Sri Lanka for importing LNG. But, to date none appear to have been accepted. Some of these proposals were for plants to be built on the southern coast where it is relatively easy to import LNG because of the availability of deep sea at a number of locations, and others were for western coast plants. Some have even received Cabinet approval for undertaking feasibility studies, while others have been included in the Ministry agenda only.

In response to a call for proposals in 2001, the government had received several proposals for the construction of LNG terminals and a NG-fired power plants with capacity of 350 MW initially and expandable to 1050 MW within ten years. However, nothing was heard of these proposals thereafter. Had these were accepted and implemented at that time, we would have had the benefit of clean power today.

According to a Ministry progress report posted in its website, the government has taken a policy decision in 2007 to include LNG as a source of fuel for future power plants and has nominated a Japanese company to develop facilities in the western coast to import LNG. The Japanese Government has apparently agreed to finance the project on concessionary terms. Subsequently, the government has sought an independent assessment report under a Japanese assistance programme with regard to the feasibility of importing LNG, but this report has not been made public yet.

The Ministry of Power and Energy had made a previous attempt to obtain LNG from Iran and an exchange of delegations also taken place. The Cabinet has also granted approval to build a 300 MW NG power plant at Mirissa (where the sea has the adequate depth to bring LNG carriers) with assistance from Iran. Though Iran has the second largest NG reserves in the world after Russia, it lacks technology to liquefy the gas for export. Their attempts to develop this technology with technical assistance from European countries failed half-way in view of the economic sanctions imposed against Iran.

Iran had entered into long-term contracts with China and India to supply them LNG, anticipating completion of its liquefaction programme, and these proposals are now kept on hold. It was during this period that Iran offered Sri Lanka too assistance to build a NG-fired power plant and supply LNG to operate it. However, with the collapse of their liquefaction programme, the project has not been pursued. The latest information is that Iran has entered into an agreement with an Indian firm to develop its liquefaction facilities and in return has assured a supply of 6 Mtpy of LNG to India on long-term basis. This is an opportunity for Sri Lanka to reopen the negotiations

with Iran.

## Situation in India on the use of NG

According to 2007 Energy Balance Statement for India given in IEA Energy Statistics, India's energy mix comprises coal (41%), oil (23%), biomass and other renewables (27%), natural gas (6%), hydro (2%) and nuclear (1%), with a total supply of 595 million tonnes oil equivalent (Mtoe) or 25,000 PJ approximately. India has its own gas fields, both off-shore and inland, but the supply, which is expected to be limited to around 160 Mcmd, is inadequate to meet the increasing demand. Hence, over the past years, India was attempting to import NG via pipelines as well as through on-shore LNG terminals.

India had commenced discussions with Pakistan in 2005 on building a gas pipeline from Iran via Pakistan. The pipeline is estimated to cost around US$ 7.5 billion and is expected to be 2300 km in length. Though there was general agreement for it by both countries, the matter did not progress much. India had also shown interest in joining the pipeline project to bring gas from Turkmenistan to Pakistan through Afghanistan. The proposed pipeline will have a length of approximately 1680 km up to the India border and a capacity of 90-100 Mcmd. However, geopolitical issues in the region probably had prevented these proposals from progressing further.

A third attempt by India to obtain NG via pipelines appears to show success. That is to import NG from Myanmar via a pipeline to be laid over Bangladesh. According to the latest information available, Bangladesh has now agreed to allow India to proceed with the project. The pipeline will be 900 km long and have a capacity of 20 Mcmd. The project is estimated to cost IRs 4,500 crore or US$ 1 Billion approximately. Myanmar has already agreed to build a pipeline to China and sell NG to them at US$ 7.72 per Million British thermal unit (MBtu), and probably a similar figure will apply to India too. In addition, there could be a toll fee payable to Bangladesh.

Within the India, there is a wide network of pipelines extending over 6,500 km, particularly in the northern half, with certain sections still under construction. When all these pipelines are commissioned by 2012, the total length of pipelines would be more than 12,000 km and the capacity is expected to increase to around 300 Mcmd. These pipelines supply NG to power plants, chemical industries, city gas distribution networks for domestic and commercial users and conversion to compressed form (CNG) for use in the transport sector in cities.

India has already built three LNG terminals in the Western coast - two in Gujarat State (Dahej and Hazira) and the third near Mumbai (Dabhol). Gas imported as LNG is sold in India around US$ 4.90 per MBtu, and this is cheaper than other fuels like naphtha, light and heavy diesel and LPG. A fourth is under construction in Kerala State at Kochi. A fifth planned in the Eastern coast at Ennore is being evaluated for feasibility. The project which has an initial capacity of 2.5 Mtpy is estimated to cost IRs 3,450 crore or US$ 766 million. These terminals have throughputs in the range 2.5 – 5 Mtpy and are expected to be expanded to 5-10 Mtpy capacity. With the expansion

of the capacity of these plants, the total LNG supply to India is expected to reach 20 Mtpy by the end of 2012.

Part II of the article - Establishing an energy hub in Trincomalee -II

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