REPORT ON TRAINING PROGRAMME - on '*LNG Business Strategies*'
conducted from 15th Nov to 19th Nov 2021.

(Ref : SEC Contract # PRG – 237 / 2021 / PROMO, dated 7th Oct 2021)

The session-wise summary report is as follows :

Session 1: Introductory & Overview of Environment of Energy

The session comprised of following topics

1. Global Energy Environment
2. Energy Transition Trends
3. SAARC Region Energy Environment
4. Natural Gas & LNG advantages
5. LNG Value Chain
6. Elements of Natural Gas / LNG Pricing
7. Regulatory Framework & Role of government
8. Gas Hubs & Exchange

Summary

The session started with the welcome of all the participants and organizers as also introduction of all faculty members. Opening remarks on the program were made by the coordinator and Deputy Director of the SAARC Energy center. The objective of the training program and broad areas to be covered was explained.

The changing trends of composition of various energy sources in primary energy mix was explained along with the slowing down of compounded annual growth rate of energy consumption. The large scale of consumption of fossil fuels is the main reason for increasing emissions leading global warming & climate change. At the same time, it is adversely impacting health of people particularly in developing economies. A great amount of disparity has emerged between the developed & developing economies with respect to energy consumption, health care and use of cleaner better technologies. A global consensus has emerged to urgently reduce the emissions under the initiatives of United Nations.

The likely future of energy based on several projections /future scenarios was explained along with their limitations. All projections & scenarios indicate a clear global energy transition trend towards cleaner energy mix. The primary energy supply is likely to peak around 2032 and energy demand by 2034. The natural gas demand may peak around 2035. There is a steady increase of renewable energy contribution, and it is expected that by 2050 the contribution of non-fossil energy would be almost 50 % in the primary energy mix with natural gas contribution reducing only marginally.

The role of natural gas is expected to grow beyond abridge fuel. Decarbonization & CCS initiatives and hydrogen as a fuel have great potential. Analysis of gas reserve indicates that the world has sufficient gas reserves to cater the increasing need of energy.

It was explained that the SAARC region is not rich in oil & gas reserves and a major importing region. This region has low per capita energy consumption. The energy demand would have robust energy demand growth but will use 62 % fossil energy till 2050.

Comparative data was shown to explain that LNG is a cleaner, cheaper and safer energy source compared to other liquid fuels and has numerous advantages. It has strong global demand forecast driven by Asia which consumes around 2/3rd of LNG supply.

The value chain of LNG was explained starting from upstream gas production its processing and transportation to a liquefaction plant where the gas is liquified and stored for shipping. The various risks involved in upstream, downstream were discussed. A robust growth is projected for global liquefaction capacity till around 2030 when the demand flattens. Controlling the increasing cost of liquefaction is a challenge for new projects.

The status of LNG shipping was discussed. The LNG shipping industry registered a 7 % growth in 2020 and has robust growth projections as per the construction orders. The FRSU industry has grown rapidly over the years within the LNG industry.

Regasification process was explained as an important part of LNG value chain. Important parts of a regasification terminal were described. The global regas capacity is growing faster with number of countries joining the LNG consuming group increasing. Floating FSRU industry has grown rapidly and a comparative advantage of a FSRU against a land-based terminal were discussed.

The concept of operating a terminal on tolling business model was explained. The pricing mechanism of gas/ LNG was explained. Why it is different from oil pricing and elements of pricing of gas & LNG were explained. Session also dealt on the reliable gas price benchmarks as also how globally different gas markets have evolved based pricing mechanisms. It was explained in session what measures can be taken in the long-term contracts to reduce the volatility in prices. The session also covered the salient features of a LNG sale and purchase agreement, the milestones in the process till signing off of the SPA. The important clauses of a typical SPA were discussed.

Session 2 : Demand & projection of energy sources and share of Natural Gas across Globe / SAARC member nations

Projections of energy demand and growth of different energy sources (including NG) across the globe / SAARC region. Benefits of NG as a 'transition fuel'.

The main topics of the session were:

- Historical trend of energy consumption of different sources
- Anticipated scenarios of source-wise energy consumption (IEO / BP)
- Economic benefits of gas over other petroleum products
- Existing share of energy sources in SAARC : Dependence on petroleum products and imports
- The existing share of Natural Gas, Expected export/import of Piped & LNG
- The growth potential for energy and in particular Natural Gas / LNG in SAARC countries
- The projections for growth of demand Natural Gas in SAARC member: Domestic and LNG imports

Summary

The session took off from it leads from the key messages of the previous session. It reiterated the scenario projections which indicate that while renewables are slated to increase their share, NG retains its share of 23-25% of global energy baskets in all the key scenarios. The emerging demand projections of Shell and IEO's WEO-2019 were illustrated.

The session moved on to the key economic indicators for potential of growth of energy in the respective SAARC member nations. A tabular compilation of GDP & its growth, Per Capita Energy consumption, Urbanization and Population growth and share in global population in all SAARC Member nations was presented. Key excerpts from, SAARC Energy Outlook 2030 was presented to reiterate the expected growth in demand for energy. Special emphasis was made on the expected increase in the demand for fossil fuels, including petroleum products, and the over-dependence on imports of these products was made.

The economic benefits of Natural Gas / LNG over other petroleum products were elaborated. Comparison of the landed cost of thermal energy in petroleum products with Natural Gas at current retail prices was analysed for India, Pakistan, and Bangladesh. For the remaining nations, which do not have the infrastructure for Natural Gas / LNG, assumptions as per industry norms were made to estimate the landed cost of Gas / LNG and assess the expected cost benefits.

Demand-Supply analysis for the present gas economies (Pakistan, Bangladesh & India) was presented, highlighting the mid-term and long-term growth potential. For the remaining five SAARC member nations which do not have gas infrastructure, the potential for penetration of Natural Gas / LNG in the energy basket and mid-term and long-term growth potential based on anticipated landed cost of NG / LNG was illustrated.

Session 3 : Key challenges for Global NG / LNG capacities

Following Topics were covered:

- A brief history of Liquefaction of Natural Gas and its Shipping
- Liquefaction technologies
- Issues and Challenges in development of LNG Facility:
    - Primary requisites
    - Identifying markets
    - Key stakeholders & scale of investment
    - Financing
    - EPC and Financial Investment Decision (FID)
    - Approximate timelines and flow of investment in implementing LNG Liquefaction plants
- Status of global LNG Capacities: Operational, under construction (including capacities that achieved FIDs in 2019 & 2020) and capacities in Pre-FID stage
- Key nations involved with developing LNG capacities
- LNG Shipping : Key characteristics, Fleet capacity, Vessel's cost, availability, and new orders, trends

Summary

The session's objective was to give a fair assessment of the future of the LNG Liquefaction and LNG Shipping sector as regards its long-term dependability from consumer's point of view. The participants were introduced to a brief history of Liquefaction of Natural Gas. Many of the existing issues have a legacy right from the early era of Liquefaction. The participants were briefed about how the key licenced technologies have evolved till the present times.

The significant feature of a NG Liquefaction plant is the high capital cost in developing Gas fields& pipelines, the LNG Liquefaction plant, the loading berths at ports and shipping. This was enumerated with an illustration of the scale of investment of LNG Canada, which is currently under implementation. Analysis of Capex in $/ton over the years was also presented to illustrate this feature. Another significant feature of developing a Liquefaction facility is the complex nature of tying up all pre-requisites (Natural gas supplies. Pipelines, Proximity to ports and local permissions), Identifying long-term Buyers/market, EPC team for the entire duration, Committed Financing and Project Implementation.

The three stages of LNG Liquefaction capacity, i.e. the Pre- Financial Investment Decision (FID), achieving the FID and the Project implementation in the Post FID stage were explained. The key activities in these stages were enumerated. An illustration of the timelines for implementation along-with requirement of manpower and flow of investment was shared with participants

The status of existing LNG capacities and those under construction (FID completion) across the globe were presented to illustrate the future liquidity in the markets. The LNG capacities planned in the USA, Russia, Qatar, Indonesia, Mozambique, Papua New Guinea were also brought out to so as to present a realistic picture of the dependability on LNG in the coming years.

Participants were next introduced to LNG shipping, and why it is a 'niche' business. The present status of shipping capacities across the globe was presented. The key developments in the sector, particularly the entry of Korean Shipyards in manufacturing of LNG Vessels and consequent reduction in acquisition cost as well as delivery time of vessels was illustrated along with other factors like diversification of ownership of vessels, orders without long-term charters etc, which indicate that the LNG

Session 4 - Global LNG Markets and Trade

Session comprised of the following main topics -

a. Brief history of global LNG trade,
b. key suppliers and consumers in global trade,
c. LNG Market liquidity,
d. breakeven costs of global LNG export projects,
e. upcoming cross-border pipelines and their impact on LNG Trade

Summary

The session started with a brief history and the origin of LNG in year 1940 and how LNG industry has grown over the years. The shale boom in USA leading to its entry as one of the major exporters of LNG in 2016 was also explained.

The next topic was on key suppliers 20 nos. and consumers over 40 nos. in global trade and how the LNG trade is growing across the world was explained at length. There after how the LNG trade has grown to over 356 MMTPA by year 2020 and the major exporters like Australia, Qatar, US and Russia and the major importers incl. Japan, China, Korea, India and growing trade between these and other nations was dealt with at length.

LNG market liquidity was the next topic which included the supply side and demand side factors such as setting up of large liquefaction capacities (450MTPA) across the world, growing shipping fleet– 572 active vessels , growth in Import markets ,- developing LNG Hubs, Re exports ,Ship reloading and Tran shipment etc. on the supply side and on the demand side-Term of contracts – getting over, period getting smaller, growing LNG capacity access- capacity holders growing, access to third parties ,traders etc. and FSRU- catering to quick ,localized and smaller demands, also the development of New Applications e.g. Bunkering, Truck loading etc. has led to growth in liquidity in LNG trade, were explained in detail to the participants.

Breakeven costs of global LNG export projects was next explained from new and old projects followed by the importance of transnational pipelines and their impact on cross border trade such as Transnational pipelines which create long term economic relations between nations for meeting energy needs,such pipelines are point to point but have limited flexibility in terms of capacity, supply volumes and destination and that the transnational pipeline projects and LNG import projects are complimentary with each other in order to meet the energy needs of the nations, the concept was presented in detail. Some examples of Nord stream 1 and 2 and TANAP and Turk stream pipelines were presented. Subsequently the opportunity for cooperation among SAARC nations through such projects such as IPI and TAPI was also emphasised.

The participants were encouraged to ask questions in order to satisfy their queries and doubts and for a better understanding.

Session 5: LNG pricing: Practices & Risk management

The session comprised of following topics:

1. LNG pricing mechanisms,
2. Factors affecting LNG prices,
3. Portfolio optimization,
4. LNG Marketing and trading,
5. Risk analysis and tools for risk management / mitigation.

Summary:

The objective of the session was to impart learning to the participants' on the International practices in LNG pricing, factors affecting price dynamics and Risk management tools available to mitigate the risk in the LNG trade.

The session started with a brief what constitute the basis of gas pricing and the international practices followed in the different markets for LNG pricing. Participants were introduced to the components of reliable natural gas pricing benchmarks. The details of various practices being followed in matured

and not so matured markets of the LNG pricing which includes gas on gas pricing followed in USA, UK and North Europe and gas prices linked to other energy/crude primarily in Asia.

Participants were explained the evolution of LNG prices at the different points of time in different markets either with hub indexation or the oil indexation. The details of various gas hubs such as HH, NBP, TTF and others were explained. Also the concept of oil indexation and slope methodology was explained in details which are being followed in Asia for long term contracts along with the importance of Floor and Caps with S curve so as to reduce the price volatility in LNG pricing. The current LNG pricing trends in long term contracts and in the spot market was also presented along with changing pricing trends.

The factors affecting the LNG prices in the international and regional markets was explained in details. The portfolio concept was explained which are prevalent in the market to reduce the risk of price and volume risk. Various techniques and practices for risk assessment, mitigation and hedging tools being followed and available to buyers was presented.

The session ended with answering various questions of the participants. The details of the presentation material which was presented during the session and the video recording of the session is available with SAARC Energy Centre.

Session 6 - LNG Contracts

The session on LNG Contracts consisted of the following topics:

1. Overview of LNG supply chain
2. LNG Supply Projects and Markets
3. Principles and Risks - formulation of LNG Contracts
4. LNG Sales and Purchase Agreements
5. Master Sale and Purchase Agreement
6. LNG Tolling
7. LNG Shipping contracts
8. LNG Regasification Contracts
9. Gas Supply contracts
10. Gas Transportation Agreements
11. Future of LNG Contracts

Summary

The session began with the topic - what constituted the elements of a typical LNG chain, it was followed by LNG projects and the risks involved in developing such a project, the same was followed by Natural gas markets and how they are grouped into four categories. The contracts and agreements required in order to link all the elements of the LNG chain were then explained. The risks associated on the seller's side and those of the buyers were then enumerated. In LNG Contracts, the factors considered by the buyers and those by sellers and their expectations, while negotiating an agreement were explained. LNG Sales and purchase agreement and salient milestones to be crosses before arriving at a final agreement were also explained. All the terms and conditions of a Sales and Purchase Agreement (SPA) were explained in detail next. Thereafter the LNG Master sales agreement for spot

trade and its difference with a SPA was explained. Changing terms and conditions and principles of an LNG tolling agreements were also informed.

Salient features of a LNG shipping contract, LNG regasification contract and gas sales and purchase agreements were also informed to the participants. At the end of the session, new trends and evolving features of the LNG contracts were also explained to the audience. The participants were encouraged to pose questions during and after the session in order to have a better clarity and understanding of the subject.

Session 7: LNG Receiving Terminals

The session comprised of following topics:

1. LNG Receiving Terminals : Introduction to the key features
2. Demand Assessment, Assurance of Off-take, Pipeline Connectivity
3. Requirement of LNG Suppliers and users
4. Capex and Financing of Land based terminals
5. FSRU : Key features and benefits
6. Comparison of Land-based RLNG terminal & FSRU,
7. RLNG Tolling contracts, RLNG Contracts with aggregators / consumers / marketing companies,
8. Small scale LNG (ssLNG)

Summary:

The objective of the session was to impart learning to the participants' on the various facets of RLNG Terminals including FSRU, Tolling and Offtake from Terminals, Contracts with Off-takers, capex needed to build these terminals etc.

The session started with explaining the capacities built in various countries of around 850 MMTPA for receiving LNG either Land based or floating on the sea and their utilization profile. The important issues to be considered by the developer for building LNG receiving terminals was discussed, such as

1. Market assessment for Demand of Gas
2. Decision on Land based or FSRU
3. Marine and Port Infrastructure
4. Technical and Financial feasibility
5. Site conditions, land availability and EIA
6. Commitment of Off-take/Use
7. Pipeline connectivity of sufficient capacity reaching to customers
8. commitment of funds from Lenders and shareholders
9. completion of construction of Terminal within time and budget
10. Operational efficiencies of terminal and its maintenance

The participants were explained the process flow chart of various technical facilities needed for the land based receiving terminal either at the marine side or on the land such as storage tanks, vaporisers, utilities etc. Also the cost and time needed to build such facilities was discussed along with the requirement of the landers. The necessities of the introduction of FSRU as an alternate to land based terminal was explained.

The comparison of the land based terminals with FSRU was presented in details. The advantage in term of cost, time needed to build, flexibilities, ability to expand, operating cost etc. was explained in details.

Participants were explained the concept of tolling and merchant model for the ragas terminal with risk and reward of the both models.

The key terms of the tolling agreement were presented along with the methodology of charging the usage fees being followed in the contracting by the developer of LNG receiving terminals.

The participants were also briefly introduced the development of small scale LNG terminals for the various needs of the consumers.

The session ended with answering various questions of the participants. The details of the presentation material which was presented during the session and the video recording of the session is available with SAARC Energy Centre.

Session 8 – Gas Supply and distribution

The session on Supply and distribution Infrastructure consisted of the following sub topics-

a. Global Environment & Energy Transition Outlook
b. Growing Energy needs & Infrastructure requirement
c. Natural Gas Pipelines- Construction process, Project life cycle, Technological norms for safety, Operation of pipelines
d Contract & common carrier Pipelines
e. Pipeline tariff models

In addition, transnational pipelines, their importance, new pipelines coming up and their impact on LNG trade was also presented during the session.

Summary

The global environment and energy transition outlook was first explained at the beginning of the session. Different scenarios projected by various consultants were also explained, and the impact thereof in future, on use of various forms of energy. Natural gas would continue to play an important role in all scenarios and therefore the need for forward planning and investments required in the LNG and supply and distribution infrastructure, across the world.

As an example, India's import dependence and long-term plans for development of LNG import regasification terminals were illustrated. The next topic was details of what constituted the pipeline infrastructure and how transmission pipelines were constructed, various stages in construction, their advantages and technological norms & standards used in construction of gas pipelines. The operation of pipelines, SCADA, and remote monitoring and control mechanism were explained next.

Thereafter, the concept of contract and common carrier pipelines was explained. The concept of calculation of pipeline tariffs through DCF method was next explained followed by tariff modelling using various concepts. Different tariff models such as postalised, Entry Exit, zonal, Cost of service etc. were explained in detail. Pipeline tariff models presently in vogue in Europe and USA were also explained, with an illustration of zonal model concept.

The session was followed by another short session on transnational pipelines and their impact on LNG trade. Some illustrations of pipelines in Europe, Russia to China and those planned in Asia incl. TAPI

were explained along with the opportunities that present themselves before SAARC countries to collaborate with each other in this regard.

Session 9: Gas Sector Regulations, Policies and Rules

The session consisted of following topics

1. Historic evolution of governance in oil & gas sector
2. Role of Government in Regulatory Framework
3. Role of a Regulator
4. Regulation of LNG Business with reference to India

Summary

It was explained that the SAARC region inherited a system which needed changes for the growth of oil & industry. For business to grow and develop an enabling environment is essential. While government has an important enabling role to regulate a business, the regulations should not be seen as restrictive and inhibit investment due to lack of transparency and inequal treatment to entities. The role of a regulator and its framework was explained. The regulator has very critical role in gas industry – approving pipelines, setting tariffs, storage of oil & gas, city gas distributions, gas hubs & exchanges, setting the technical standards for pipelines, plants, equipment, material etc. as also for safety standards to be followed by the industry.

It was explained that for a specific sector of activity an exclusive regulator is recommended. There would be a separate regulator for upstream, midstream and downstream, however a close coordination is required between them.

Regulatory system in SAARC countries was discussed for upstream, midstream and downstream. The requirements of a good regulatory framework was explained. Regulatory system in Pakistan and India were discussed. Some of the key notification issued by the Indian regulator were listed. A case study of CGD in Indian context was shown as to how enabling role of a regulator can help a sector to develop fast with progressive policy changes.

The regulatory framework for LNG business in India was discussed as an example.

Session 10: Gas Hubs & Exchanges

The session comprised of following topics:

1. Key requisites for the development of a Gas 'Hub'.
2. Major gas hubs,
3. Gas exchanges and their role in growth of gas markets.
4. **Feasibility of a South Asian Gas Hub**

Summary:

The objective of the session was to impart learning to the participants' on the Importance of hubs/exchange and their role in the growth of gas markets.

The session began with the explaining of the concept of Gas Hub and Gas exchange and their importance for a competitive gas market. The important pre-requisite for building Gas Hubs and Exchange was presented in detail as under:

1. A hands-off government approach on natural gas - Shift from direct policy making and market involvement to market monitoring through an independent anti-trust agency (Regulator)
2. Separating transport from commercial activities - The independent transport entity will levy a fair and indiscriminate transmission fee and provide access for all shippers
3. Price deregulation at the wholesale level of natural gas - Let the market set the wholesale price level for natural gas
4. Sufficient network capacity of transmission - Sufficient network capacity will ensure that no separate "islands" that behave according to their own supply/demand dynamics
5. Non-discriminatory access of network – Non-discriminatory access will increase the number of market participants
6. Involvement of financial institutions - Providing tools for risk management for customers to smooth out and optimise revenue streams from their activities in the natural gas market

Participants were explained the various functions performed by the Gas hubs and how gas trading occurs in the market. The parties to the gas hub and exchange and their role were discussed as under:

1. Government- Only for policy direction
2. Regulators for framing regulations, monitoring and facilitating trade (Gas/Financial)
3. Buyers, sellers, traders, financial operators etc.
4. Infrastructure owners (Pipeline, storage, terminals)
5. Brokers- mediates between market parties and thus simplifies the search for counterparties to sell/buy gas and helps create awareness of OTC deals
6. Role of Hub operator, Transmission System Operator (TSO) and the Gas Exchange.

The liquidity on the gas exchange as an important factor was discussed and concept of churn ratio was explained. The participants were also explained the difference in the physical hub and virtual hub. The schematic diagram of the Henry Hub, NBP and TTF was presented and explained how these hubs functioned. The other terminologies used and the importance of Balancing hub, financial hub and Benchmark hub were also discussed.

The necessities of having LNG hubs was also presented and the important pre-requisite for the LNG hub was also discussed. Though lot of efforts have been made by various countries in Asia such as China, Singapore and Japan but still we do not have an effective LNG hub yet. However, various countries in Asia are now developing their own gas hubs, as transnational pipeline connectivity has not yet been in place.

The experience of India for the creating of local gas exchange was presented namely India Gas Exchange (IGX). It was concluded that till pipeline connectivity happen, Gas consuming SAARC countries may start developing their own physical gas hub/exchange, similar to what has been made possible in India.
The session ended with answering various questions of the participants. The details of the presentation material which was presented during the session and the video recording of the session is available with SAARC Energy Centre.

Session 11 : Potential for trade in SAARC

Following topics were covered

- Key drivers for intra-regional trade
- Trade options: Sale-Purchase, Swaps, Tolling
- Potential of trade amongst SAARC member nations: Short-to Mid-term plays
- Objectives for long-term collaboration: Establishing a sound infrastructure for cross-border trade and establish a South Asian Gas Hub / Exchange.

Summary

The participants were introduced to the key drivers for intra-regional cooperation and trade, which are to overcome the gaps in demand- supply, benefit from shared infrastructure and provide opportunities for investment and trade, thereby helping in the Socio-economic growth of the region.

Benefits of different trading options like Sale-purchase, Lending & borrowing, LNG Cargo Swaps, Collaboration in LNG (like availing 'tolling', investment in cross-border pipelines, shared purchase of LNG cargoes) were explained to the participants. The strategic benefit of leveraging the collective bargaining power of the region is a long-term vision. Expected financial benefits was presented to illustrate the potential of intra-regional cooperation and cross-border trade.

Three possible plays in cross-border trade were taken up

- Pakistan – Afghanistan
- Sri Lanka – India – Bangladesh – Pakistan
- India – Bangladesh – Nepal – Bhutan

For each of the above, the emerging demand-supply gaps were mapped as per the available projections in public domain. For gas supplies, the domestic production and the RLNG (existing & planned) were taken. The demand was also mapped from the available projections. For Pakistan, the IGCEP 2018-40 projections for gas demand for power sector was considered. Assumptions were made for the gas supplies from domestic sources, the likely gas flows from the Iran-Pakistan and the TAPI gas pipelines and the gap in demand-supply in Afghanistan.

Sri Lanka's proposed trading hub at Hambantota would offer significant options for short-term trades for balancing volatility in demand for Pakistan, India and Bangladesh

From the demand supply analysis for India and Bangladesh it emerged that by 2025, while India could be surplus in gas supplies, Bangladesh's existing gas production could decline and its gap in demand-

supply could widen. This provides a natural opportunity for trade amongst these nations. Such a proposal is also mooted in the energy plans of Bangladesh for their Power Sector (PSMP) and Gas Sector (GSMP 2017).

The emergence of Small scale or Virtual LNG supply chain provides significant opportunities for penetration of gas in the energy markets of Nepal and to some extent in Bhutan. The landed cost of RLNG from India indicated scope for trade, particularly in the provinces of Nepal bordering India, which also have fairly dense population and higher economic activities. Similar analysis was done for Bhutan, which can avail benefits in replacing HSD and in supplementing its LPG requirement.

(Dr A K Balyan, Sh Rajeev Mathur, Sh R K Garg, Sh Swami Dayal Prasad)