“Assessment of the Present Situation and Gaps in Capacity, Technology and Policy & Regulatory Instruments in Coal Sector of SAARC Member States”

SAARC ENERGY CENTRE

Energy for Peace & Prosperity

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Foreword

The foreseeable extensive use of Coal warranted a detailed study which could highlight the potential of coal in SAARC Member States in terms of encompassing gaps in capacity, technology and policy & regulatory Instruments. As a matter of fact, coal significantly contributed towards the socio-economic progress of United States, Australia and China. Today's developed nations not only relished *coal-based economy* but are also developing clean coal and coal conversion technologies. However, in SAARC Member States, coal could not become a major energy component in past except in India where coal has a long history of utilization and industrial application.

With time, there emerged a need to develop and formulate a set of guidelines for the Member States that could help in revising their energy policies and ensuring the justified role of coal in a diversified energy mix. However, this was only possible by assessing the actual resource potential, identifying the environmentally-compatible technology forefronts, directions to develop human resource potential and infrastructure, comparative analysis of existing and future energy policies, particularly with reference to coal and pinpointing the pathways for achieving coal-based regional collaboration. Additionally, this assessment study could, possibly, lay the foundations of a mechanism for achieving regional integration and energy sustainability.

Precisely, the report addresses status of coal reserves, utilization patterns, issues related to coal mining, coal supply chain management, coal-based power generation technologies, environmental effects, need of human resource potential, status of coal in foreseeable future around the globe, regulatory frameworks, and need of regional policy framework. However, the biggest challenge was assembling a set of formulations by gathering all this scattered information into one piece. Much of the information, presented in this report was scattered and lacked intra-regional cooperation on the subject, thus necessitating the preparation of an updated document. No doubt, there must have been some components that could have been included in the report, but at this point of time, this work can be propagated for achieving the true purpose of this assessment.

December'2017

Mohammad Naeem Malik
Director

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Executive Summary

According to *Copenhagen Accord (2009)*, the biggest challenge for the developing countries is poverty alleviation while addressing the rising challenge of climate change, equally. Industrial growth and energy security & sustainability drive Socio-economic development of any country. In SAARC region, unfortunately, not a single member country has been able to provide electricity to all households. According to *Electricity Access in 2009 (World Energy Outlook 2011, IEA),* 68.5% of the total population in developing Asian countries has access to electricity, more precisely, 15.5% of Afghanistan, 41% of Bangladesh, 75% for India, 43.6% of Nepal, 62.4% of Pakistan, and 76.6% of Sri Lanka. As a whole, 493.4 million population is living without access to electricity in SAARC region.

Fossil fuels will remain the key source of primary energy as renewables are not yet a competitive replacement. Among fossil fuels, coal can be associated with a number of key attributes including abundance, accessibility, energy security, reliability, affordability and versatility, as a result of which coal would be continuing to play an important role in meeting global energy demands for more than 100 years. Currently, as per estimates of 2014, 40.8% of electricity is being supplied from coal based power generation (Key World Energy Statistics, 2016), thus being the largest single source for electricity generation. Additionally, considering the prospective role of coal in meeting energy demands, it has been estimated that an additional 3800 TWh of electricity will be generated through coal by 2035, which indicates 44% increase (The Global Value of Coal, 2012). The pivotal role of coal in industrial revolution has set an example of rapid societal progress of China, which can be evidenced as, "Coal has underpinned China's massive and unprecedented growth in output, fueling an economic miracle that has helped to improve the standard of living" (Cleaner Coal in China, IEA 2009).

In SAARC region, most of the countries possess coal reserves and yet a large amount of reserves is untapped. Pakistan has 175 billion tonnes of untapped lignite reserves at Thar, which presents a unique opportunity for uplifting regional economy. As of now, only six blocks have been awarded to private companies for development. However, there is a need to expedite the development of Thar coal by allocating more

blocks for mining and power generation purposes. Pakistan should also shift its dependence from imported coal to Thar coal reserves that can be used in various energy recovery schemes including power generation. Bangladesh and Afghanistan have 3.3 billion tonnes and 66 million tonnes, respectively, which are largely unexploited. The tapping of these reserves may provide an opportunity for economic uplifting of the region through the generation of direct and indirect employment opportunities.

Mining practices in all SAARC region except India are obsolete, manual and labour intensive. These practices need to be mechanized for meeting increasing coal demands of the region. Coal India Limited (CIL), the largest coal producing company in the region, has not been able to ensure anticipated domestic coal production, thus requiring the import of 166.557 million tonnes of coal for the year 2013-14 (Coal Directory of India, 2013-14). The major reason for this inefficient productivity is the limited involvement of private sector in coal mining. Similarly, Pakistan's annual coal production is 3.4 million tonnes that is much below than its future plans for coal power generation through China-Pakistan Economic Corridor (CPEC). Mining practices are at the same stage where Britain left the country and obsoleted. Mining is the major bottleneck in the utilization of indigenous coal. Pakistan needs to develop its mining infrastructure along with supply chain. As a matter of policy, private investment in coal mining sector must be encouraged and facilitated through tax relaxation schemes, so that targeted coal productivity can be ensured. Alongside, legislations should be introduced across the region for improving residential, health and safety standards of miners in accordance with the international standards. Coal towns can be developed for the facilitation of mining workers in the vicinity of coal producing areas.

In addition to the development of coal mining industry, there is a dire need to improve coal supply chain infrastructure, as well. Rail networks need to be developed in SAARC countries, other than India, for the transportation of coal. The improvement in supply chain infrastructure will not only increase the availability and accessibility of coal but also boost transportation industry, creating numerous employment opportunities. Coal washing and upgradation facilities must be installed at mine

mouths so that the transportation cost of coal can be reduced in addition to the improvement of coal quality.

In SAARC region, power generation is the major use of coal, which will increase in near future owing to upcoming coal fired power projects in India, Pakistan and Bangladesh. Though, power generation will remain the predominant use of coal, however, other uses of coal also need to be explored, for instance, role of coal as chemical feedstock, use of coal in fertilizer production and provision of alternative fuel options through gasification. India has traditional low efficient and high emission producing coal power plants, which need to be upgraded with modern clean coal technologies. Within the region, India happens to be the largest contributor to coal-based pollutant emissions, as coal-based power generation capacity of India is 186,493 MW (as of October, 2016) and 90% of India's coal fired power generation plants are based on subcritical technology. As per Ministry of Environment, Forest and Climate Change (India), for existing coal fired power plants, the emission standards for particulate matter, SO_x and NO_x are in the ranges of 150 to 350 mg/Nm^3, 200 to 600mg/Nm^3 and 300 to 600mg/Nm^3, respectively. Though, for new coal based power plants, emission standards have been revised but still those are not comparable to the standards of USA and European Union (EU).

This scenario not only necessitates the immediate upgradation of India's existing coal fired power plants but also requires future installation of supercritical based technology or higher in India. Another allied aspect is the regional synchronization of environmental standards for, effectively, controlling emissions of pollutants from coal based power generation. Now, time has come for taking the initiative of establishing SAARC Environment Control Standards at regional level in order to ensure the improvement in existing standards in the light of those, which are being practiced in European Union and USA. Moreover, in conjunction with increased use of coal, carbon capture and storage technologies would have to be integral component for coal based power generation in order to mitigate carbon dioxide emissions. Investments to achieve this objective can be pursued from Green Climate Fund (UNFCCC, 2010). Carbon trading credits schemes can be launched in SAARC countries. India contributes to 98% coal originated CO_2 emissions in the region. Since high-efficient and low-emission (HELE) technologies, such as Integrated Gasification Combined

Cycle (IGCC) require large initial capital cost, the role of private investors can be expedited. A number of incentives like tax relaxations etc. can be offered for attracting investors for the development of coal sector from coal mining to utilization.

Considering the potential of coal in SAARC region, there is also a need to establish SAARC Coal Centre, which, in a broader perspective, could provide a platform for promoting the efficient coal utilization in the region. Particularly, this Centre can play role in terms of energy and resource hub for;

1. Developing mechanism for technology transfer within the region from countries with developed coal sector to the countries, which need to enhance the role of coal in energy mix
2. Development of human resource potential with special reference to the requirements of coal industry
3. Advancing research & development in coal sector for exploiting the use of coal for fertilizer production and as a chemical feedstock
4. Reassessment and Reevaluation of Coal Resources for actual estimation of reserves in SAARC region
5. Organizing workshops, training, seminars and conferences for promoting cleaner use of coal

Conclusively, the probable extensive use of coal in SAARC region will require addressing environmental concerns during mining and utilization of coal. 21st Century Clean Coal technologies have the potential of addressing all environmental concerns with increased plant efficiencies and reduced per unit cost. In short, energy poverty of the region can be eradicated by adopting clean coal based industrial growth, which would definitely lead to economic growth along with meeting climate challenge with the help of 21st century clean coal technologies.

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Purpose of the Study

The study presents baseline situation of coal sector, asses the technology, policy & human resource capacity and put forward recommendations to promote the role of coal for sustainable development of SAARC region.

Objectives of the Study

The objectives of the study were as follows;

1. Assessment of the Present Scenario of Coal Sector in SAARC Member States
2. Identification of the Gaps in Policy Framework for Efficient Utilization of Coal Resources
3. Existing Practices of Extraction and Supply Chain Management of Coal Resources in SAARC Member States
4. Identification of Key Coal Utilization Sectors, End User Technologies and Environmental Mitigation of Coal for Each Member State
5. Role of Coal in Energy Security from SAARC Regional Perspective
6. Capacity Building and Technology Transfer Options and Opportunities

Scope of the Study

This study provides an extensive overview of coal sector in SAARC region with special reference to the current status of coal sector in the region, indication of gaps in production and demands, assessment of coal technologies in practice and, lastly, prospective role of coal in the social and economic progress of the region.

Limitations in the Study

Key limitations, faced during conducting the study, were as follows;

1. Present study was primarily conducted based upon published literature, however, limited data was available related to geological occurrence of coal in SAARC member states, particularly, for Afghanistan and Bangladesh posed difficulties.
2. In some countries of the region, coal production and consumption data might not have been well reported owing to limitations of the governing bodies. The actual production and consumption numbers might be higher than reported for Afghanistan, Nepal and Bangladesh.

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Abbreviations

%	Percentage
°C	Centigrade
Afs	Afghani
AICTE	All India Council for Technical Education
atm	Atmospheric
BP	British Petroleum
BTK	Bull's Trench Kiln
$CaCO_3$	Calcium Carbonate
CaO	Calcium Oxide
$CaSO_4$	Calcium Sulphate
CCS	Carbon Capture & Storage
CCT	Clean Coal Technologies
CFBC	Circulating Fluidized Bed Combustion
CHP	Combined Heat and Power
CIL	Coal India Limited
CO	Carbon Monoxide
$CO(NH_2)_2$	Urea
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
COS	Carbonyl Sulphide
CPEC	China-Pakistan Economic Corridor
Dept.	Department
DMC	Dense Medium Cyclone
DMV	Dense Medium Vessel
EIA	Energy Information Administration
EP/ESP	Electrostatic Precipitator
ESIR	*Environmental and Social Impact Report*
EU	European Union
FBC	Fluidized Bed Combustion
FeS_2	Pyrite
$FeSO_4$	Ferrous Sulphate
FGD	Flue Gas Desulphurization
FIFO	First in, First Out
FYP	Five Year Plan
g	Gram
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GSB	Geological Survey of Bangladesh
GSP	Geological Survey of Pakistan
Gt	Gigatonnes
GW	Gigawatt
GWe	Gigawatt Electrical
GWh	Gigawatt-hour
H_2O	Water

H_2S	Hydrogen Sulphide
Hele	High Efficiency-Low Emission
HgS	Mercuric Sulphide
HHV	High Heating Value
HUBCO	Hub Power Company Limited
IEA	International Energy Agency
IGCC	Integrated Gasification Combined Cycle
IISCO	Indian Iron and Steel Company
IPP	Independent Power Producer
JORC	Joint Ore Reserves Committee
KBC	*Khoshak Brothers Company*
Kg	Kilogram
KPK	Khyber Pakhtunkhwa
KW	Kilo Watt
KWh	Kilo Watt-Hour
LHV	Low Heating Value
LNB	Low NO_x Burners
LNG	Liquefied Natural Gas
M/P&E	Ministry of Power and Energy
MCO_3	Metal Carbonate
MEA	Monethanolamine
mg	Milligram
MJ	Mega Joule
mm	Millimeter
MO	Metal Oxide
MoMP	*Ministry of the Mines & Petroleum*
MPa	Mega Pascal
MSD	Musculoskeletal
Mt	Million Tonnes
Mtoe	Million Tons of Oil Equivalent
MW	Mega Watt
N_2	Nitrogen
N_2O	Dinitrogen Oxide
Na_2SO_4	Sodium Sulphate
NCE	North Coal Enterprise
NH_3	Ammonia
Nm^3	Normal Meter cubed per Hour
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NTEVTA	National Technical Education & Vocational Training Authority
O_2	Oxygen
PAC	Powdered Activated Carbon
PC/PCC	Pulverized Coal Combustion
PCC	Pulverized Coal Combustion
PFBC	Pressurized Fluidized Bed Combustion

pH	Potential of Hydrogen
PLC	Public Limited Company
PLC	Programmable Logic Controller
PM	Particulate Matter
R & D	Research & Development
R/P	Reserve/Production
RES	Renewable Energy Sources
RINL	Rashtriya Ispat Nigam Limited
ROM	Run of Mine
SAARC	South Asian Association for Regional Cooperation
SCC	SAARC Coal Centre
SCCL	Singareni Collieries Company Limited
SCR	Selective Catalytic Reduction
SDA	Semi-Dry Absorption
SG	Specific Gravity
SNCR	Selective Non-Catalytic Reduction
SO_2	Sulphur Dioxide
SO_3	Sulphur Trioxide
SO_x	Sulphur Oxides
SSRL	Sino-Sindh Resource Private Limited
Syngas	Synthesis Gas
TEVTA	Technical Education & Vocational Training Authority
TISCO	Tata Iron and Steel Company
TWh	Terawatt-Hour
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USD	US Dollar
USGS	United States Geological Survey
VSBK	Vertical Shaft Brick Kiln
VSP	Vizag Steel Plant
W/A	Weighing/Analysis
µm	Micromilimer