Shaping the Future of Sustainable Energy in Asia and the Pacific

Prospects for Cleaner and More Efficient Coal Production and Utilization Technologies in North-East Asia

UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

APEF2013
THE ASIAN AND PACIFIC ENERGY FORUM

The Economic and Social Commission for Asia and Pacific (ESCAP) is the regional development arm of the United Nations committed to providing a multilateral platform to its 53 member States and 9 associate members. ESCAP promotes regional cooperation to achieve inclusive and sustainable economic and social development.

This publication was prepared by the ESCAP consultant, Mr. João Aleluia, and draws primarily on the findings and recommendations of the national country studies. We appreciate the effort of the following contributors and peer reviews for ensuring the quality and relevance of the joint study: Ms. Hu Yuhong, National Center for International Cooperation of the State Administration of Work Safety (China); Mr. Keiji Makino, Japan Coal Energy Center (JCOAL); Mr. Budeebazar Avid, Institute of Chemistry and Chemical Technology, Mongolian Academy of Sciences; Mr. Byoung-hwa Lee, Pusan University Clean Coal Center (Republic of Korea); Mr. Evgeny Gorlov and Ms. Galina Agapova, the National Mining Research Center at A. A. Skochinsky Institute of Mining (Russian Federation). The project benefitted from the inputs made by Mr. Milton Catelin, Chief Executive, and Ms. Aleksandra Tomczak, Policy Manager, the World Coal Association. Grateful thanks are extended to Mr. Jeff Williams who created cover design and layout.

This publication is not an official document of the United Nations Economic and Social Commission for Asia and the Pacific. The views expressed in the publication do not necessarily represent those of ESCAP. The designations and terminology employed and the presentation of materials do not imply any expression of opinion whatsoever on the part of the United Nations concerning energy and environment.

The publication was prepared with the support of the Russian Federation.

Copies of this publication may be obtained from:
Energy Security and Water Resources Section
Environment and Development Division
United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)
Rajadamnern Nok Avenue
Bangkok 10200, Thailand
Tel: (66-2) 288 - 1234
Fax: (66-2) 288 - 1048 / 1059
Email: escap-esdd-ers@un.org

Table of Contents

Executive Summary

Coal has been the fastest growing energy fuel since the beginning of the XXI century, and currently it accounts for around 30 % of the primary energy consumed worldwide. The analysis of coal's role in the global energy context would be incomplete without considering the context and realities of countries in North-East Asia (NEA), a sub-region consisting of China, the Democratic People's Republic of Korea, Japan, Mongolia, the Republic of Korea and the Russian Federation.

Although encompassing "just" six countries, NEA is a vast territory covering a diversified population of 1.7 billion and a GDP that equates to 24 % of the world's total. In full tandem with the demographic and economic dimensions of the sub-region, one third of the world's primary energy is consumed in NEA. With respect to the importance of coal in the energy mix, the picture is fairly different, with NEA countries consuming 58 % of the coal produced worldwide. Given the massive demand for energy and the availability of large and affordable coal resources, it is reasonable to expect coal to continue to be as a major source of primary energy in the years to come in the sub-region.

A heavy dependence on coal has significant environmental and social costs, which include the depletion of natural resources, severe impacts on air quality, and the emission of greenhouse gases. These damaging impacts on the environment and the society have spurred the need for a more sustainable and balanced development of the coal sector. To a large extent, the development and diffusion of technologies that process coal in more efficient and less damaging ways is key to bringing countries worldwide, and those of NEA in particular, into a more sustainable pathway.

Set against this backdrop, this study aims at assessing the current status of coal technologies in NEA, with a focus on "cleaner coal", and attempts to identify priority areas and opportunities for sub-regional cooperation on these technologies. By "international cooperation" it is meant the scope for different levels of public policy intervention, which include, among others, state-led cooperation on R&D activities and academic exchanges, the formulation of common strategies on a bilateral or multilateral basis on coal technology development, and intergovernmental cooperation on capacity building and knowledge sharing activities.

This study is primarily based on inputs provided by experts from NEA countries, and it covers a set of different areas related to the production and utilization of coal, which consist of the following: efficiency-enhancing coal technologies; coalbed methane recovery and utilization; coal gasification; coal liquefaction; and carbon capture and storage.

The assessment revealed that most countries in NEA have placed a relatively high priority to the development of cleaner and more efficient coal technologies, from the upstream to the downstream of the coal value chain. Different levels of technology development and adoption are observed in NEA countries as a whole. For example, the development of supercritical and ultra-supercritical coal combustion technologies, which in NEA has been driven by countries such as China, Japan and ROK, seems to be on par with international standards. On the other hand and also as an example, the uptake of coal drying or coalbed methane utilization technologies seems to be somewhat lagging behind developments elsewhere.

The analysis also concluded that cooperation among NEA countries on many coal technologies already exists on an inter-firm and commercial basis. On the other hand, at the R&D and demonstration stages, cooperation among NEA countries appear to be fairly limited, the same

applying to capacity building and knowledge sharing activities among these countries. Finally, at policy and regulatory level – such as the harmonization of standards or the development of common visions or strategies among countries – no joint initiatives were identified.

For each of the technology areas examined, the study came up with the following suggestions of priority areas for international cooperation among NEA countries:

Short to Mid-Term Priorities and Recommendations

Advanced Coal Combustion Technologies:

- NEA countries should continue their policies of accelerating the deployment of advanced coal-fired power generation technologies by creating the necessary enabling framework, either in terms of policies, targets, regulations or a combination of these.
- NEA countries should support – or continue supporting – emerging advanced-coal combustion technologies, such as advanced-USC pulverized coal combustion, the deployment of larger CFB boilers (so as to achieve the economies of scale of the largest commercially available pulverized coal combustion boilers), and the full-demonstration of SC and USC steam conditions applied to fluidized bed combustion boilers.
- International cooperation among NEA countries could be instrumental in introducing cleaner, low-emissions and more efficient coal combustion technologies in Mongolia and DPRK, where older, more polluting and less efficient power plants continue in operation.

Coal Beneficiation Technologies:

- NEA countries should continue and further increase their support to accelerate the deployment of coal upgrading technologies, particularly in overcoming some of the barriers that hinder their dissemination, such as the creation of pricing mechanisms that reflect the improved quality of upgraded coal.
- International cooperation among NEA on these technologies has the potential to be further enhanced, particularly in the formulation of harmonized quality requirements for imported coal and in exploring possibilities for joint R&D and demonstration programmes. Priority areas for sub-regional cooperation are on less water intensive processes and dry separation technologies, where the know-how of countries such as Japan could be explored on commercial applications.

Coal Mine Methane Recovery and Utilization Technologies:

- Policymakers of NEA countries with active coal mining activities should ensure that the necessary policies, regulations and frameworks are in place to spur the deployment of the most up-to-date technologies and best practices for the recovery of CMM so as to ensure, first and above all, the safety of mining operations.
- Opportunities for cooperation among NEA countries on CMM recovery and utilization technologies and methods include the sharing of best practices on coal mining safety, CMM technology needs and technology matching assessments, and support in the design of policies and regulations.
- NEA countries could explore synergies and opportunities for cooperation on technologies that make it possible to derive economic value from low-quality CMM gas and ventilation air methane, particularly by incentivizing national R&D institutions to develop such programmes.

Short to Mid-Term Priorities and Recommendations

Coal Liquefaction Technologies:

- There is a clear scope for the utilization of CTL technologies, including those developed by organizations in China, in projects and/or initiatives in the sub-region, particularly in Mongolia and the Russian Federation, as these are the NEA countries endowed with domestic coal resources and CTL could be a means to derive a higher economic value from those resources, in particular those that are considered "stranded".
- While CTL technologies can play an important role in enhancing energy security in the sub-region, NEA countries should ensure that the development and deployment of these technologies is based on sound technical and environmental requirements, in particular with respect to water utilization and the emission of CO_2. NEA countries could work together towards the definition of such standards or requirements.
- The market for some liquids that can be produced from coal is still incipient – if existent at all – in most countries in the sub-region. As such, policymakers of NEA countries could play an important role in the creation of those markets in articulation with each other, whereby "win-win" situations would be created by matching the supply and demand for these products.

Integrated Gasification Combined Cycle (IGCC):

- IGCC is emerging as a viable coal-conversion technology for power generation, and its deployment should be encouraged by governments of NEA countries until the technology is fully proven on a commercial basis.
- NEA countries could explore the potential for the harmonization and coordination of the different initiatives on IGCC development that are observed in the sub-region, for example through information sharing activities and the use of common methodologies.

Mid to Long-Term Priorities and Recommendations

Carbon Capture and Storage Technologies:

- NEA countries that are most active on CCS technologies, i.e. China, Japan and ROK, could further harmonize their R&D efforts and explore opportunities for the development of joint demonstration projects.
- NEA countries could synergize efforts in the definition of a common policy and regulatory framework for CCS development, a critical aspect for the uptake of these technologies both at national and sub-regional levels. NEA countries could also introduce requirements for the introduction of the CCS-Ready concept, in order to avoid the "lock-in" of building power-generation facilities that are unable to be retrofitted with CCS in the future.
- NEA countries could develop a vision for an integrated CO_2 transport, utilization and storage infrastructure in the sub-region, which could be developed in parallel and/or in complement to comparable regional initiatives, such as the Asian Energy Highway. Such vision could be initiated by China, Japan and the Republic of Korea due to their geographical proximity and strong interest in CCS, and possibly expanded to include other NEA countries.

Coal Gasifier Technologies:

- It is recommended that countries such as China, Mongolia and ROK pursue and/or continue their policies of encouraging the deployment of gasification technologies from overseas' providers, through inward technology transfer, while building-up the know-how of national companies and organizations on these technologies.
- There is potential for exploring the competitive advantages of nationally-designed coal gasifiers of China and the Russian Federation, specifically in what concerns their cost-effectiveness vis-à-vis other commercially available models. The characteristics of Chinese and Russian models could be of interest, in particular, to DPRK and Mongolia, which have limited know-how and experience on coal gasification technologies.

Underground Coal Gasification Technologies:

- Government support can be instrumental in accelerating the commercial viability of UCG technologies, not only on the R&D and pre-commercial stages, but also in addressing existing gaps in legislation and regulation, such as in the definition of environmental criteria for UCG development and guidelines for site-selection. These opportunities could be explored in articulation among NEA countries, particularly the Russian Federation, China and Mongolia.

Coal Drying Technologies:

- NEA countries seem to be somewhat lagging in the adoption of coal drying technologies, and given their importance in deriving higher value from low-rank coals, which are abundant in countries of the sub-region, it is recommended that this can be an area of increased attention, whereupon opportunities for government induced R&D could be explored.

List of Abbreviations and Acronyms Used

ADMFB	Air-based dense medium fluidized bed separation
CCS	Carbon Capture and Storage
CBM	Coalbed Methane
CFB	Circulating Fluidized Bed
CFBC	Circulating Fluidized Bed Combustion
CHP	Combined Heat and Power
CLC	Chemical Looping Combustion
CMM	Coal Mine Methane
CO_2	Carbon Dioxide
CTL	Coal-to-Liquids
CRIP	Controlled Retractable Injection Point
DME	Dimethylether
DPRK	Democratic People's Republic of Korea
ECNEA	Energy Cooperation in North-East Asia
EOR	Enhanced Oil Recovery
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EU	European Union
F-T	Fischer-Tropsch
FBC	Fluidized bed combustion
GHG	Greenhouse Gas
Gt	Gigaton
GW	GigaWatt
HRSG	Heat Recovery Steam Generator
IEA	International Energy Agency

预览已结束，完整报告链接和二维码如下：

https://www.yunbaogao.cn/report/index/report?reportId=5_4859