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Center of influence shifting in the wider resource market
21st Century Coal: Fueling Economic Growth of ASEAN

September 8, 2014

Layton Croft
Vice President, External Relations - Asia
ASEAN Coal Dynamics

**Key Discussion Themes**

- ASEAN undergoing significant growth in coal generating capacity
- Member nations strategically positioned to secure reliable, low-cost supply of coal
- 21st Century Coal advances ASEAN’s energy, economic and environmental goals
Strong Growth Forecast for ASEAN Coal Generating Capacity

ASEAN Coal Generating Capacity to Increase Significantly by 2017

Represents Up to 90 - 130Mmt Additional Coal Consumption

Potential Growth in Coal Capacity 2013 – 2017

Vietnam 19
Indonesia 9
Thailand 1
Philippines 5
Malaysia 2
Other 3

Sources: Platts, Peabody Energy Analytics and Wood Mackenzie
New ASEAN Generation Capacity to be Dominated by Coal

Over 50% of Total New Capacity Additions Expected to be Coal-fueled

- Currently 24 GW of new coal capacity under construction, more than all other fuel types combined
- Additional 14 GW of new coal capacity under development
- Attractive economics and lower delivered costs drive ASEAN generation mix towards greater use of coal

Sources: Platts, Peabody Energy Analytics, and Wood Mackenzie
Coal Remains the Most Affordable Fuel

- Coal remains the most affordable, reliable, sustainable fuel option
- ASEAN member nation Indonesia is one of the most competitive global thermal coal producers

Sources: Bloomberg, ICAP, PIRA and Peabody Analytics.
Graph represents current market prices for forward contracts sourced from the various commodity exchanges. All prices are delivered except Asia Gas/LNG.
Energy demand of the 10 countries that make up ASEAN has risen 250% since 1990.

Economic and demographic trends suggest that considerable growth is still to come, especially given that the per-capita energy use of the region’s 600 million inhabitants is low, at 50% of the global average.

Southeast Asia’s energy demand is set to increase by more than 80% by 2035; this supports a near tripling in size of the region’s economy.

Coal is increasingly the fuel of choice over natural gas.

Coal remains relatively abundant and affordable; cost of generating power from coal is now around half that of gas.

~75% of the thermal power generation capacity under construction in ASEAN countries is coal-fueled.

Source: IEA World Energy Outlook, Southeast Asia Energy Outlook, October 2013
ASEAN Nations Ideally Placed to Secure Reliable, Low-Cost Supply

2012 Seaborne Coal Volumes (Mmt, Met and Thermal Combined)

Source: Peabody Analytics, Wood Mackenzie, McCloskey and other sources
ASEAN Nations Ideally Placed to Secure Reliable, Low-Cost Supply

Source: Peabody Analytics, Wood Mackenzie, McCloskey and other sources
Coal: The World’s Fastest Growing Major Fuel

- Coal projected to fuel largest percentage of global electricity generation growth
- Coal grew dramatically faster than all other major fuels in past decade
- IEA and other observers project that coal will overtake oil as world’s largest energy source in coming years

*Expected Electricity Growth (2011 – 2035)*

Global New Coal Generation

Megawatts Added Since 2010

227,171
China

68,199
India

6,237
Germany
13,140
USA
1,320
Italy
1810
Brazil
1,810
Brazil
1,320
Italy
2,304
Chile
270
New Caledonia
300
Sri Lanka
300
Botswana
60
Guatemala
700
Mexico
972
Poland
670
Bulgaria
160
Kazakhstan
2,590
Turkey
662
Russia
600
N. Korea
590
S. Korea
50
Taiwan
1,216
Philippines
3,770
Vietnam
827
Thailand
120
Cambodia
102
Singapore
114
Australia
10,787
Indonesia
Data Supports a Strong Correlation Between Coal Use and Growing Economies

United Nations Links Affordable Energy to Quality of Life

Every 10-Fold Increase in Per Capita Electricity Use Drives a 10-Year Increase in Longevity

Since 1970, coal use has increased approximately 335%

Energy Poverty: The World’s Number One Human and Environmental Crisis

Half the world’s population lacks proper energy access; Energy poverty is fourth leading cause of death globally, killing >4 million per year.

One billion people receive substandard care in health facilities from lack of electricity; 2.5 billion people lack improved water sanitation facilities.

In developing world, half of children attend primary schools with no electricity; Lack of electricity stunts economic advancement.

Coal is abundant, reliable and low cost; Fuels over 30% of global energy use and is the fastest growing major fuel in the world.
The Effects of Global Energy Poverty are Devastating

- Nearly 3 billion people use primitive stoves to burn wood or biomass to cook and heat homes.
- Rudimentary cook stove smoke exposure is equivalent to exposure to 400 cigarettes per hour.
- 4 million people die each year from household air pollution.

World Turns to Coal to Improve Quality of Life for Millions of People

Life Expectancy

Coal Consumption

Source: UN; Yale Environment 360 Blog.
Urbanization Drives Greater Coal Use to Fuel Growing Electricity Demand

- World needs more energy as populations migrate to urban centers and embrace modern living
- More than 70 million people expected to be added to cities each year through 2020
- Coal is the only affordable fuel, at scale, to meet rising energy needs

21st Century Coal Advances ASEAN Energy, Economic and Environmental Goals

The U.S. Model: Emissions Decline 90% Since 1970, Coal Use Nearly Triples

Today’s Advanced Coal Technologies Remove Majority of Localized Emissions

Low-NO\textsubscript{x} Boiler Technology

Today’s super-critical power plants are highly efficient, creating more energy per ton of coal used. Within the boiler, NO\textsubscript{x} levels are reduced by lowering the temperature of the flame.

Selective Catalytic Reduction (SCR)

An SCR further controls NO\textsubscript{x} emissions by injecting product into the air stream as it passes over a catalyst, converting the NO\textsubscript{x} to nitrogen and water. The SCR also helps control mercury.

Dry Electrostatic Precipitator (ESP)

The dry ESP removes virtually all particulates from the air stream in addition to some mercury. The dry ESP uses electrodes to place an electric charge on the particles, which are captured on an oppositely charged plate. The particles are then shaken from the plates and collected.

Sulfur Dioxide (SO\textsubscript{2}) Scrubber

SO\textsubscript{2} is dramatically reduced by injecting a lime-stone and water mixture into the air stream, where it reacts to capture or "scrub" the SO\textsubscript{2}. Scrubbers also help control mercury.

Wet Electrostatic Precipitator (ESP)

The air stream passes through the scrubber into a wet ESP, which will remove fine particulates and other constituents. Wet ESPs use multiple high-voltage fields to attract the particles to an electrode, which is then washed with water to capture the constituents, including some mercury.

Supercritical coal plants operate at high efficiencies that significantly reduce emissions on a per kilowatt hour basis. In the United States, these plants can achieve a carbon dioxide emission rate that is as much as 25 percent lower than the oldest coal plants.

Source: U.S. Energy Information Administration.
Every Advanced Coal Plant Equal to Taking ‘A Million Cars Off the Road’

“A single, large coal plant, if built with the best-available technology, can reduce emissions by the annual equivalent of taking a million cars off the road…”

Maria van der Hoeven
Executive Director
International Energy Agency
December 2012

Advanced Coal Generation
569 GW On Line and Under Construction

China 325 GW
U.S. 92 GW
ROW 45 GW

Russia 15 GW
Germany 16 GW
S. Korea 20 GW
India 25 GW

Supercritical and ultrasupercritical operating plants and plants under construction.
Clean Coal: The Power Fueling Advanced Energy for Life

Advanced Coal Technologies
Lower Emissions

Advanced generation and control technologies drive improved efficiency and lower emissions; Large suite of technologies available today

Proven Results
Show Path Forward

U.S. experience demonstrates tremendous environmental results while increasing coal use with today’s advanced coal technologies

Next-Generation Technologies to Further Progress

Research and development underway to advance goal of coal-fueled power virtually free of emissions, including carbon capture technologies
Next Generation Technologies: Continuous Path Forward

Efficiency Improvements at Existing Plants

Building New Supercritical and Ultra-Supercritical Plants

Demonstrating and Deploying IGCC and Carbon Capture, Utilization and Storage

Advance Carbon Capture, Use and Storage and Btu Conversion Applications

Retrofitting Existing Coal-Based Generation with Carbon Capture/Storage Up to 90% Lower CO₂

CO₂-Enhanced Oil Recovery, Producing 4 Million b/d

The Goal: Near-Zero Emissions

20 years
World Can Use Far More Coal, While Achieving Environmental Results

Peabody Plan: Five Key Steps To Meet Societal Goals

- Ensure at least half of new generation from coal
- Replace older coal plants with supercritical plants
- Develop 100 CCS projects in a decade
- Deploy coal-to-gas, coal-to-chemicals, coal-to-liquids
- Commercialize near-zero emissions technology
Policy Recommendations for ASEAN Economic Community

- Continue to assert the right to drive economic and social development, and the betterment of people’s lives, through the use of abundant, available global coal resources

- Increase the deployment of modern emissions control technologies in ASEAN’s coal-fueled generation fleet

- Adopt the principles of 21st Century Coal by implementing the highest standards for worker safety, resource recovery, land restoration and water use in ASEAN’s mining sector
Conclusion

- Demand for coal in ASEAN continues to increase dramatically
- Greater use of coal provides reliable, sustainable access to low-cost energy and drives economic growth
- Coal can, does and should provide clean energy to help people live longer and live better
- ASEAN holds competitive coal market position, both strategically and geographically
- 21st Century Coal advances ASEAN’s energy, economic and environmental goals
21st Century Coal: Fueling Economic Growth of ASEAN

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What can be done to enhance ASEAN’s competitiveness in attracting the global investment capital the industry needs?

**INVESTMENT COMPETITIVENESS**

- Trends of consolidation and pull back by global operators
- Rising tide of the Americas
- Perception other regions offer easier access & less red tape
- Smaller relative share of global CAPEX in next decade
What can ASEAN do to enable the industry to better meet the challenge of a maturing MO&G resource base?

**MATURE RESOURCE CHALLENGES**

- More complex technical challenges to manage
- Rising costs to maintain and grow production
- Need for more flexible & cost efficient operators
- New skills and more talent to deliver the same volume
THANK YOU