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Advanced Energy



21st Century Coal: Fueling Economic Growth of ASEAN

September 8, 2014

Layton Croft
Vice President, External Relations - Asia

Peabody
ENERGY

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



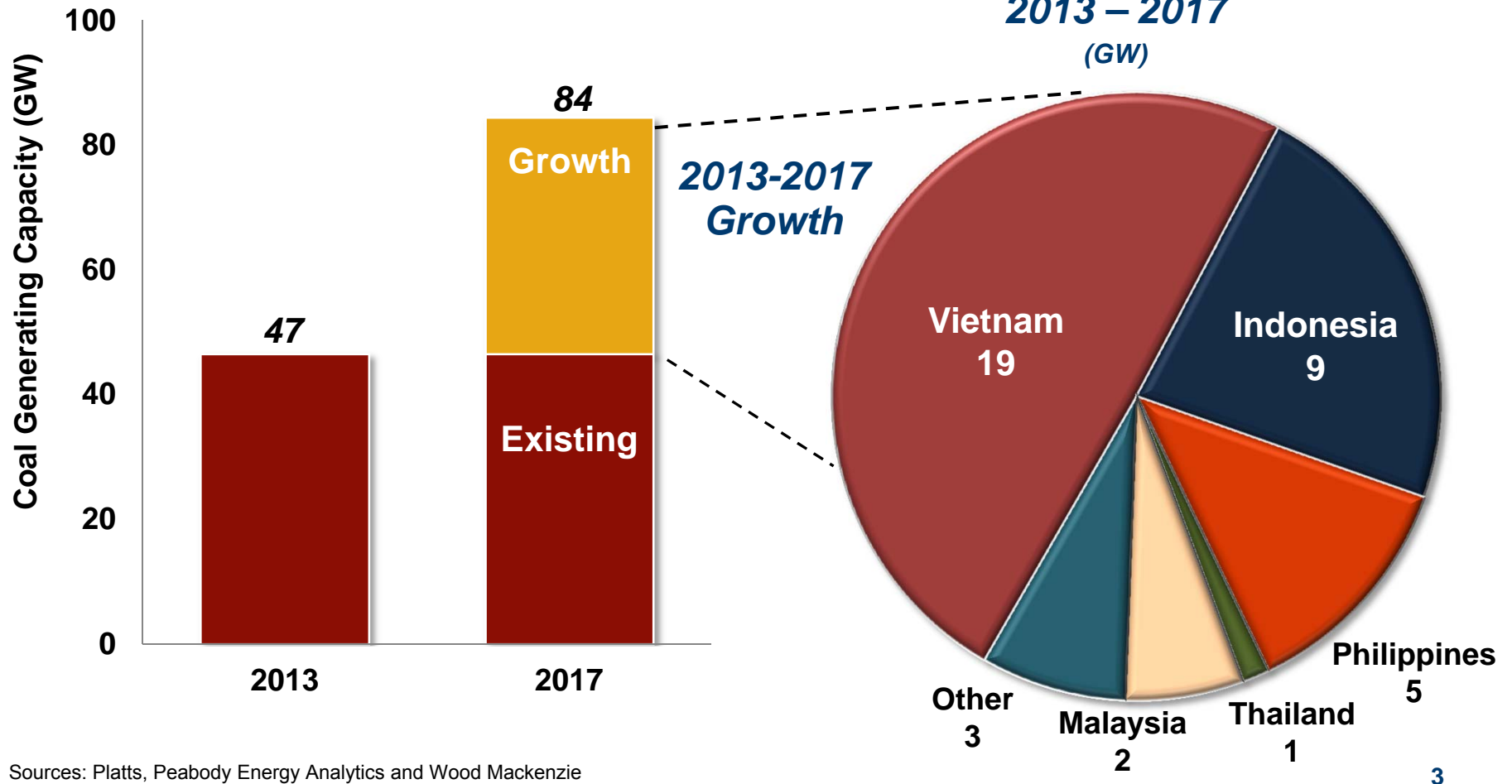
Strong Growth Forecast for ASEAN Coal Generating Capacity



ASEAN Coal Generating Capacity to Increase Significantly by 2017

Represents Up to 90 - 130Mmt Additional Coal Consumption

Potential Growth in Coal Capacity 2013 - 2017 (GW)



Sources: Platts, Peabody Energy Analytics and Wood Mackenzie

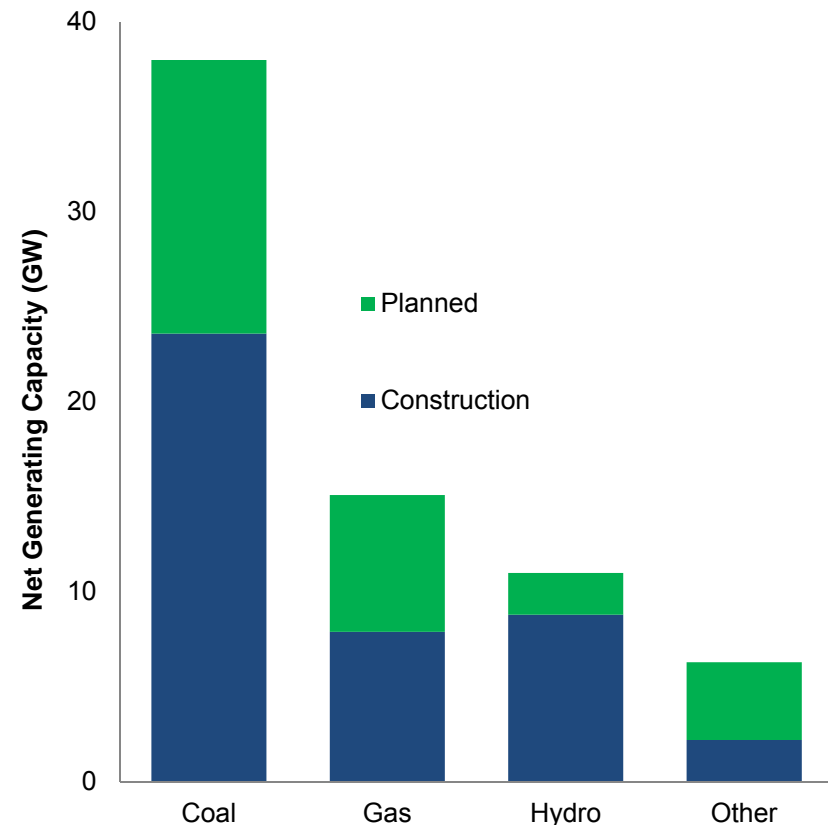
New ASEAN Generation Capacity to be Dominated by Coal



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

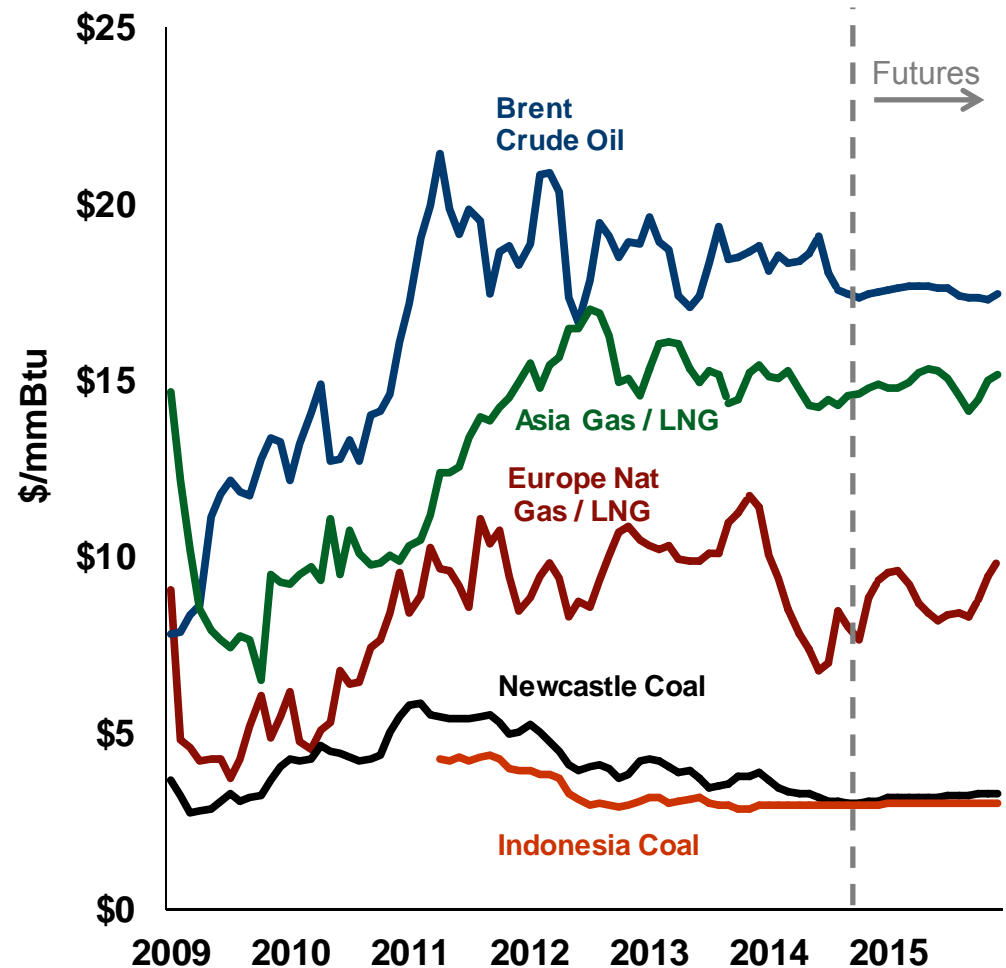
**Growth in Generating Capacity
2013 – 2017**



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.

International Energy Agency Southeast Asia Energy Outlook

Commentary from IEA Chief Economist, Dr. Fatih Birol

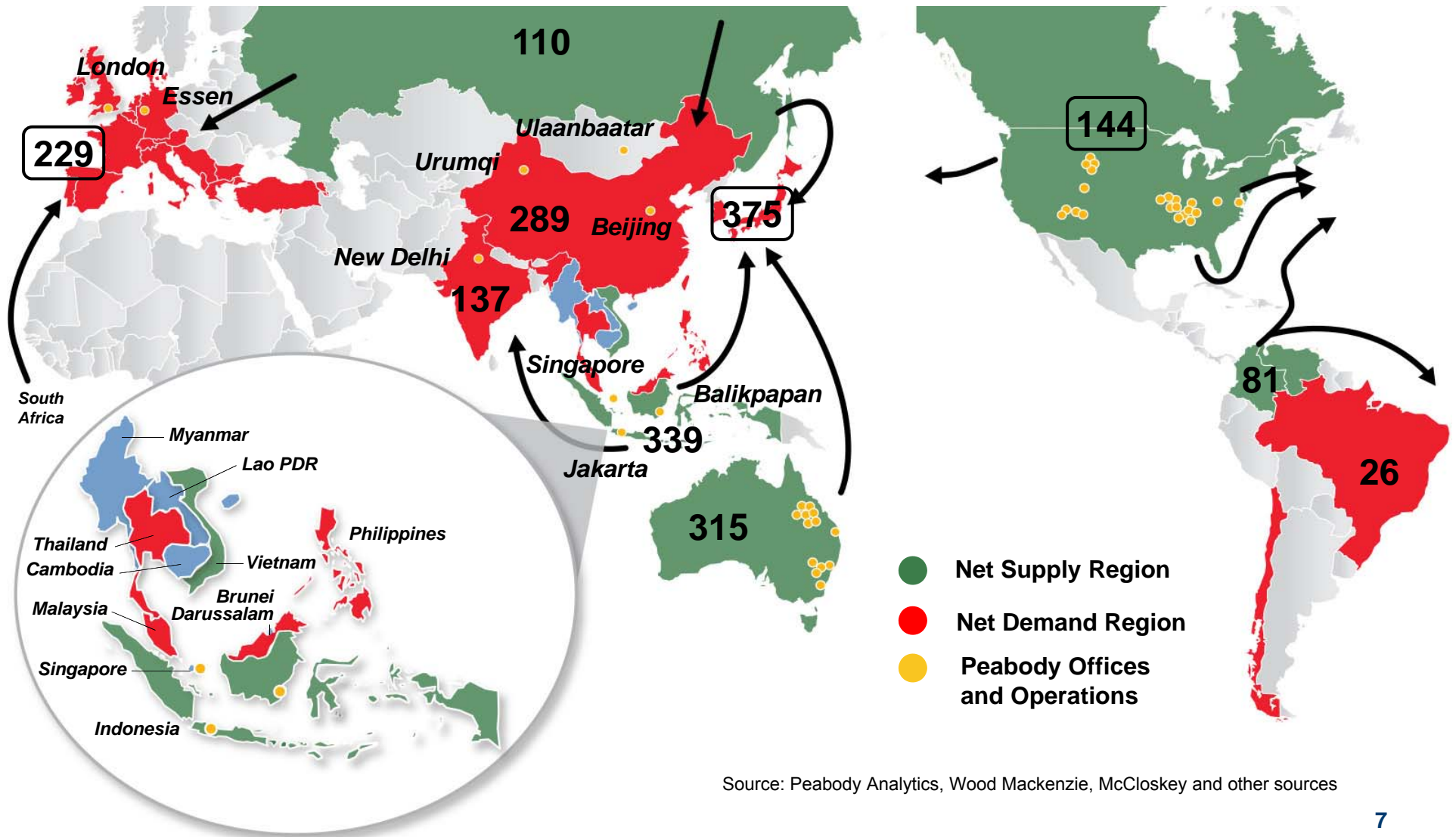
- Energy demand of the 10 countries that make up ASEAN has risen 250% since 1990
- Economic and demographic trends suggest that considerable growth is still to come, especially given that the per-capita energy use of the region's 600 million inhabitants is low, at 50% of the global average
- Southeast 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



ASEAN Nations Ideally Placed to Secure Reliable, Low-Cost Supply

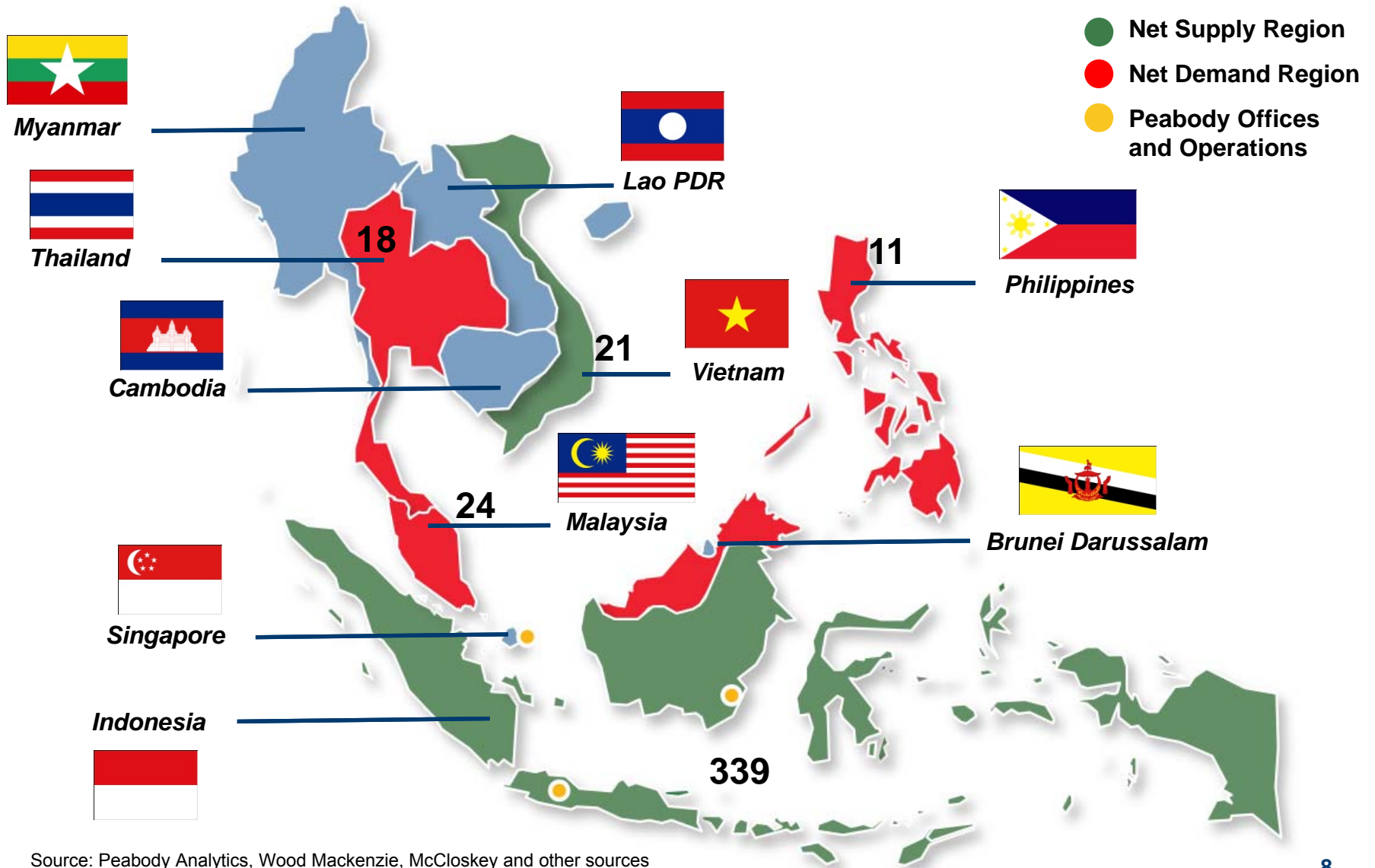


2012 Seaborne Coal Volumes (Mmt, Met and Thermal Combined)



Source: Peabody Analytics, Wood Mackenzie, McCloskey and other sources

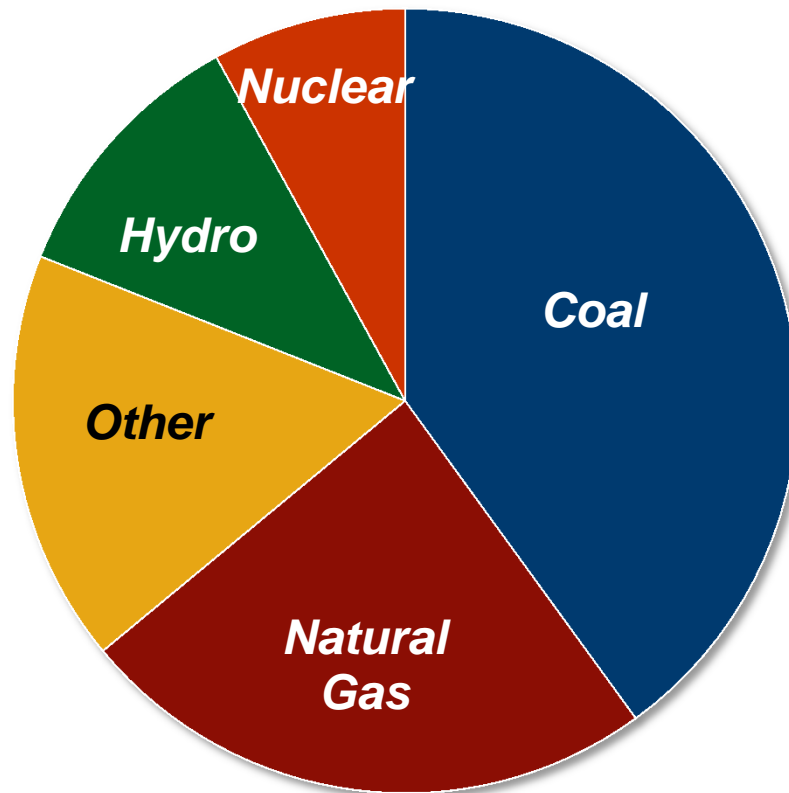
ASEAN Nations Ideally Placed to Secure Reliable, Low-Cost Supply



Source: Peabody Analytics, Wood Mackenzie, McCloskey and other sources

Coal: The World's Fastest Growing Major Fuel

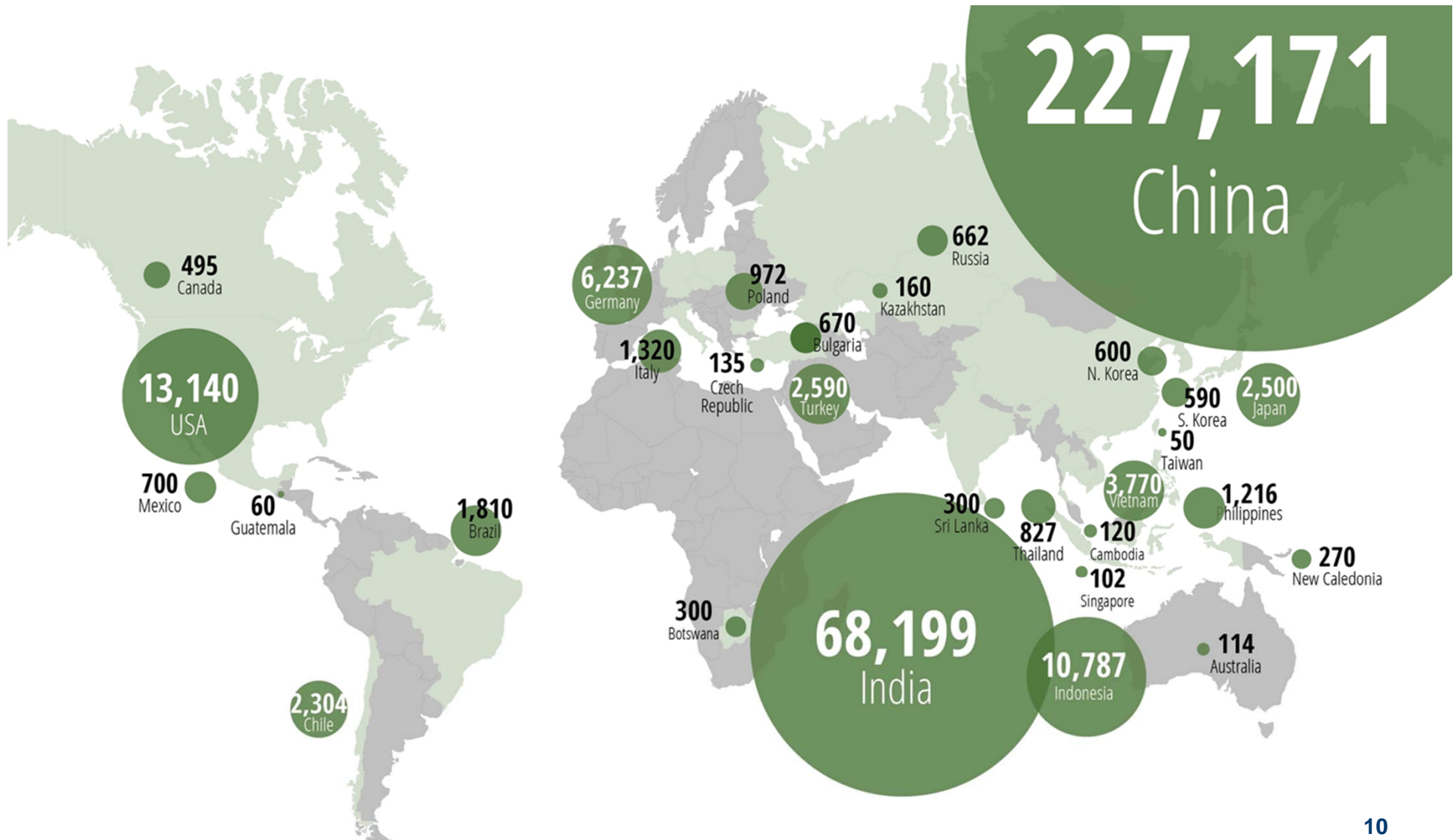
*Expected Electricity Growth
(2011 – 2035)*



- 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

Global New Coal Generation

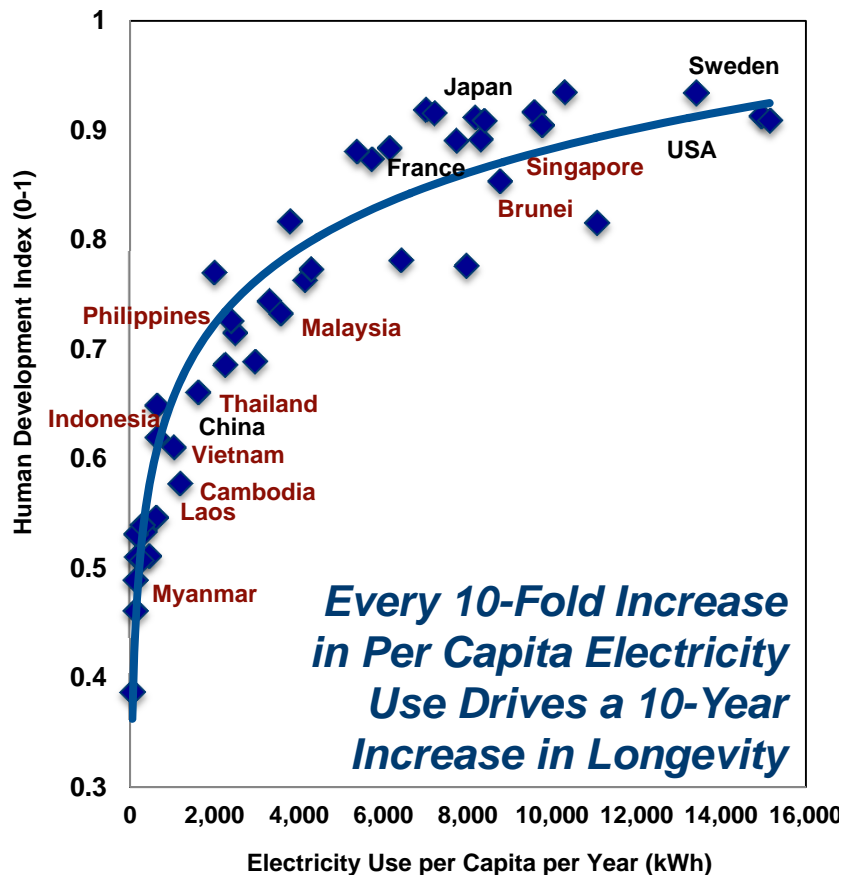
Megawatts Added Since 2010



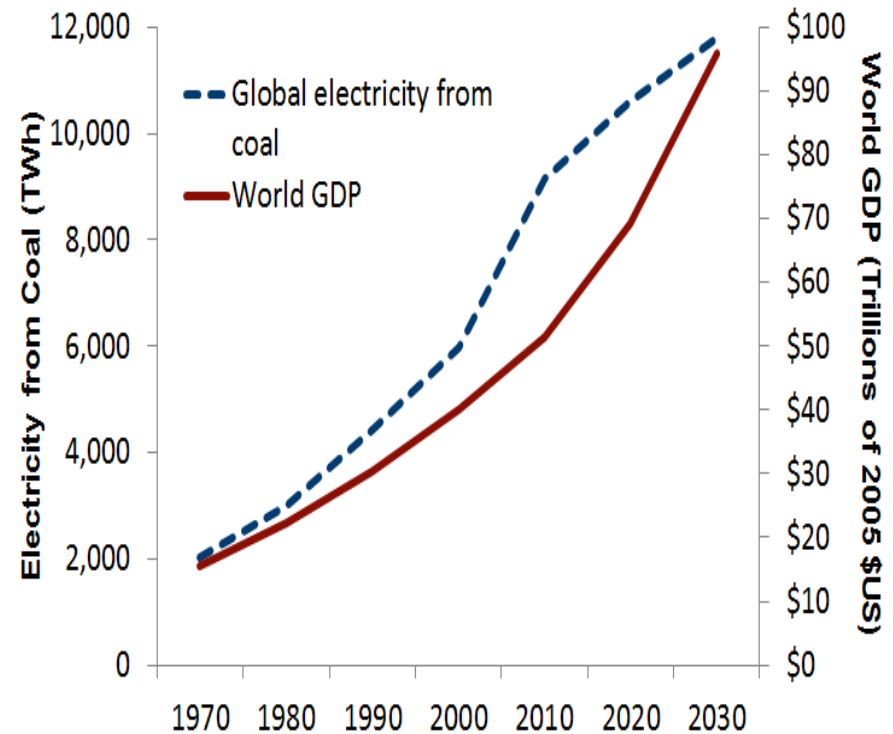
Data Supports a Strong Correlation Between Coal Use and Growing Economies



United Nations Links Affordable Energy to Quality of Life



Since 1970, coal use has increased approximately **335%**



Sources: CIA World Fact Book, United Nations Development Program's Human Development Report.; Developed from International Energy Agency World Energy Outlook (1995-2013); USDA 2011.

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



Global Energy Poverty Effects are Devastating

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

Energy Essential for Health and Longevity

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

Energy Access Linked to Economic Growth

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

Coal Key to Solutions for Energy Access

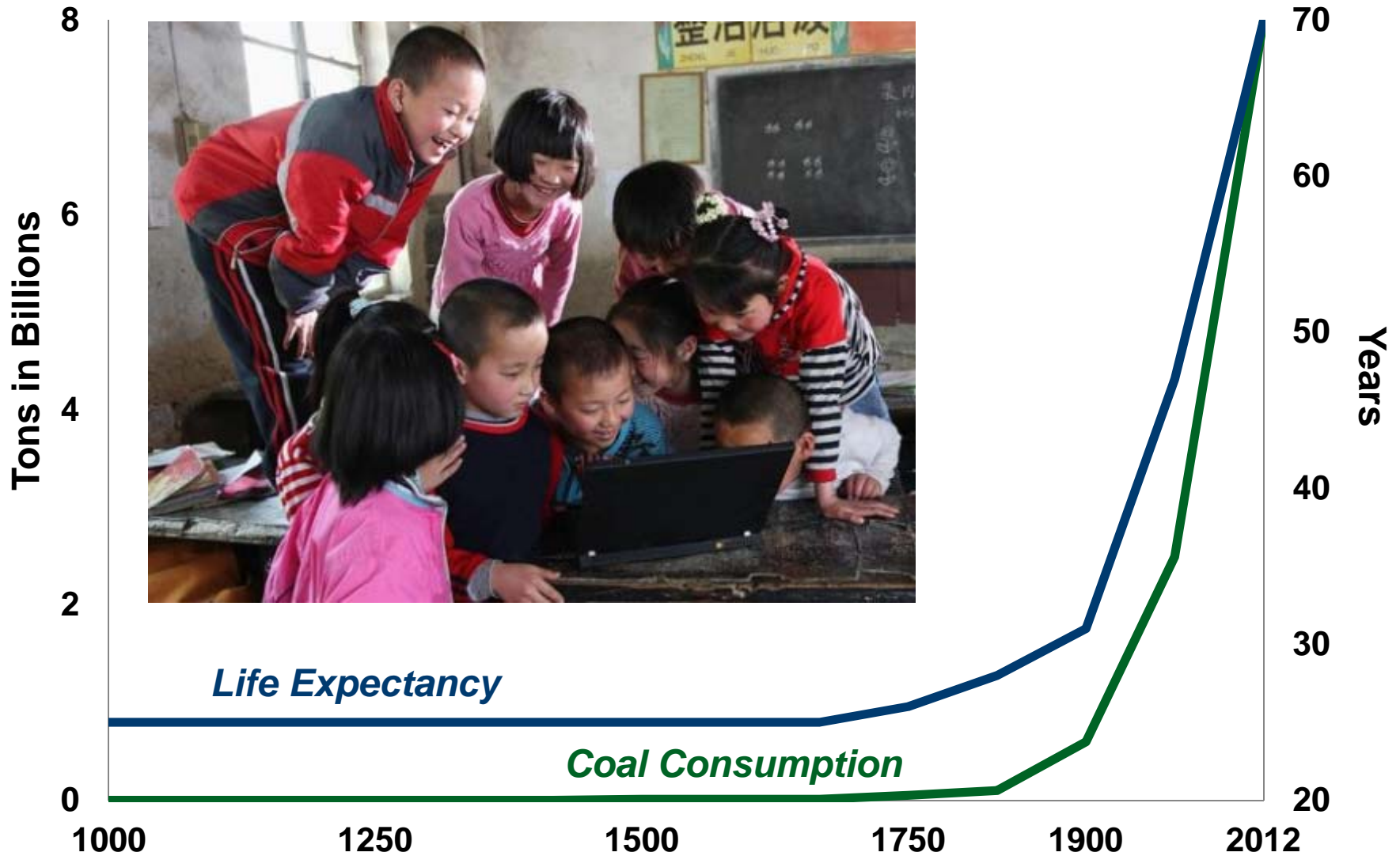
Coal is abundant, reliable and low cost; Fuels over 30% of global energy use and is the fastest growing major fuel in the world

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

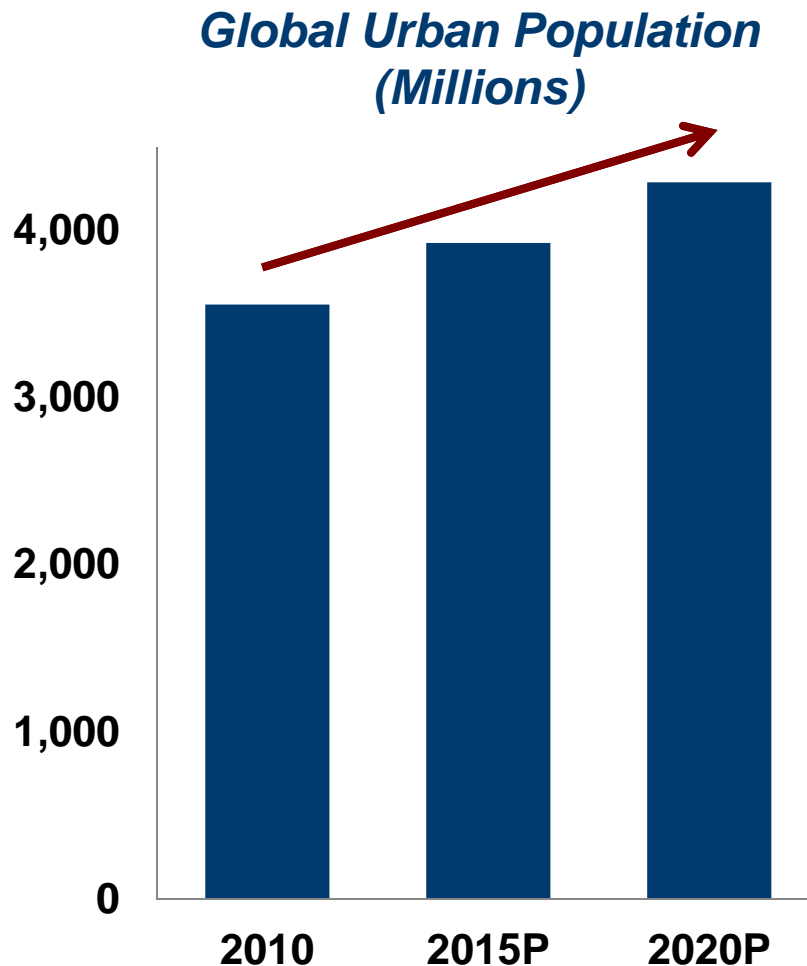


Source: UN; Yale Environment 360 Blog.

Urbanization Drives Greater Coal Use to Fuel Growing Electricity Demand



200,000 People Added to Cities Each Day

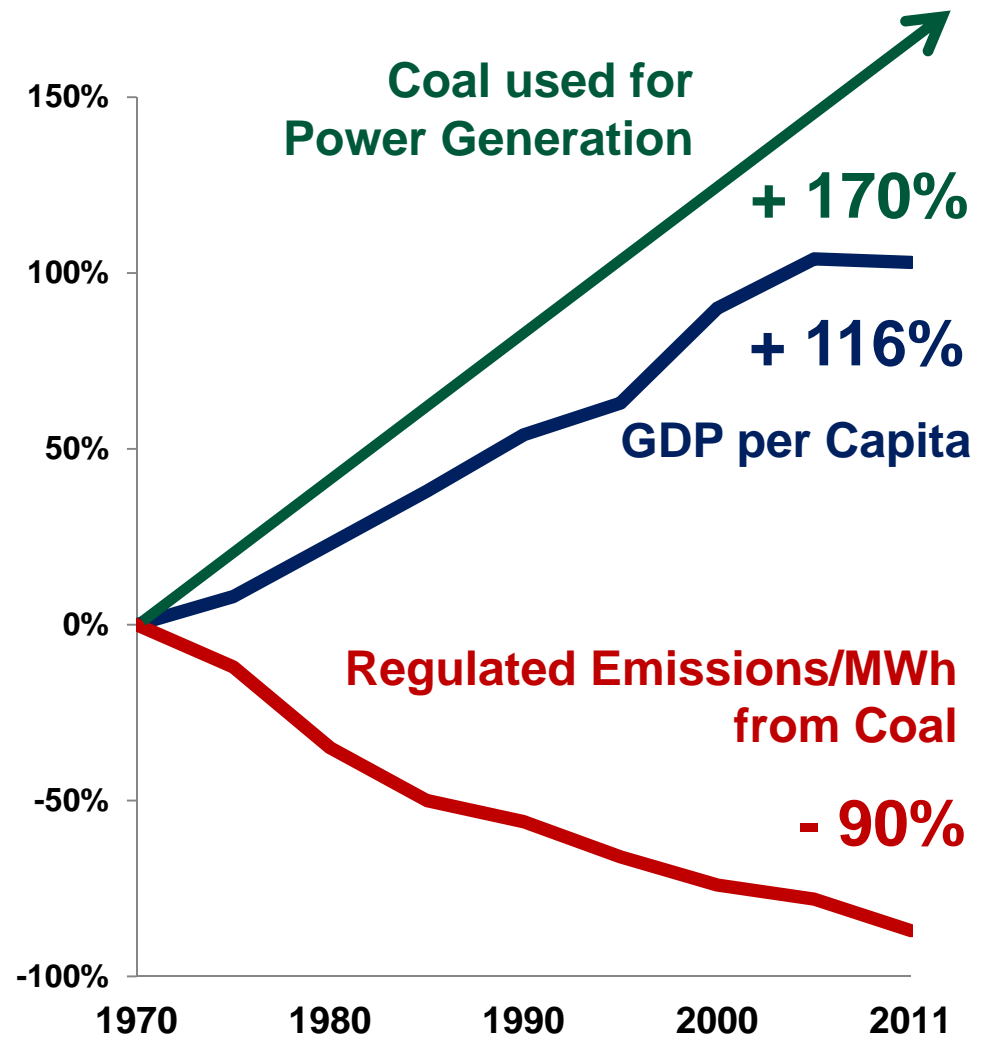


- World needs more energy as populations migrate to urban centers and embrace modern living
- More than 70 million people expected to be added to cities each year through 2020
- Coal is the only affordable fuel, at scale, to meet rising energy needs

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



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



Sources: Energy Information Administration 2013; U.S. EPA Air Trends Data, 2013; USDA 2011 GDP in 2005 dollars.

Today's Advanced Coal Technologies Remove Majority of Localized Emissions



Low-NO_x Boiler Technology

Today's supercritical power plants are highly efficient, creating more energy per ton of coal used. Within the boiler, NO_x levels are reduced by lowering the temperature of the flame.

Selective Catalytic Reduction (SCR)

An SCR further controls NO_x emissions by injecting product into the air stream as it passes over a catalyst, converting the NO_x to nitrogen and water. The SCR also helps control mercury.

Dry Electrostatic Precipitator (ESP)

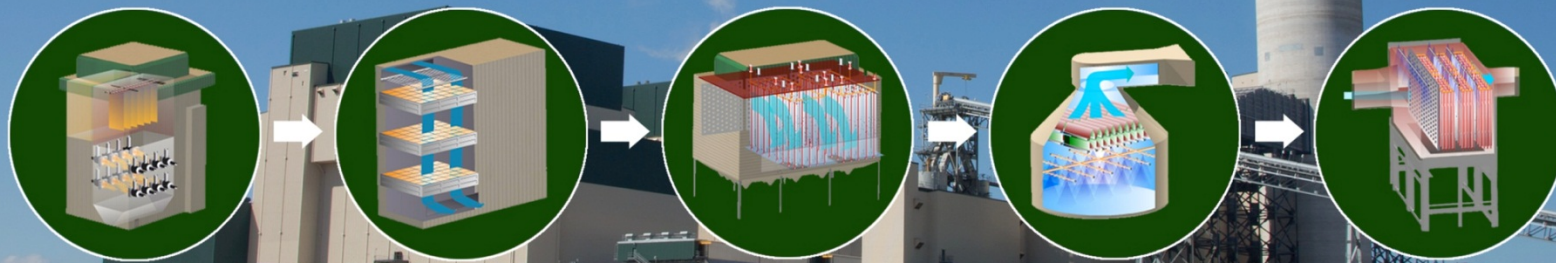
The dry ESP removes virtually all particulates from the air stream in addition to some mercury. The dry ESP uses electrodes to place an electric charge on the particles, which are captured on an oppositely charged plate. The particles are then shaken from the plates and collected.

Sulfur Dioxide (SO₂) Scrubber

SO₂ is dramatically reduced by injecting a lime-stone and water mixture into the air stream, where it reacts to capture or "scrub" the SO₂. 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.

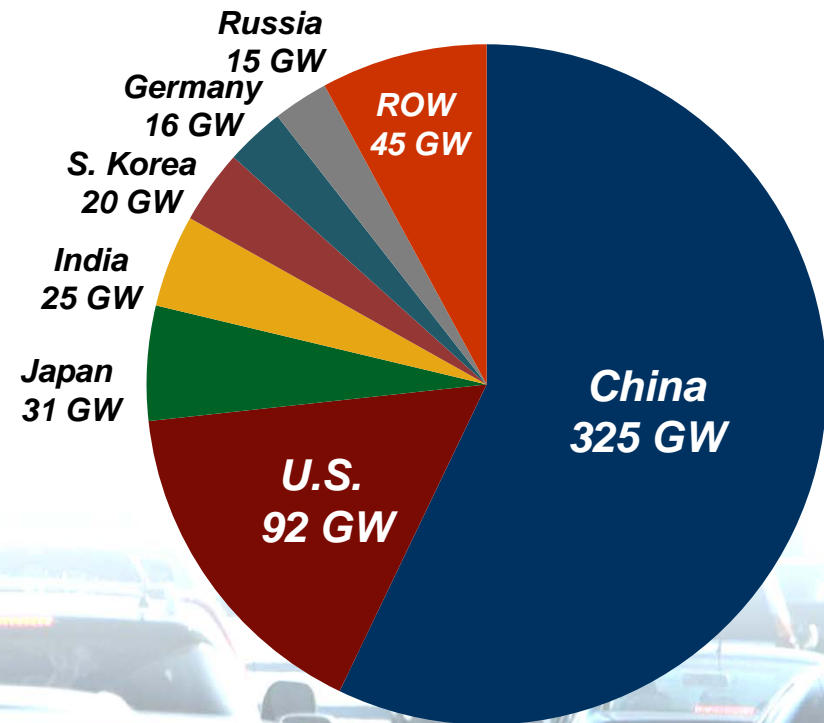
Every Advanced Coal Plant Equal to Taking 'A Million Cars Off the Road'



“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



Supercritical and ultrasupercritical operating plants and plants under construction.

Source: Platts World Electric Power Plant Database. December 2013. Huffington Post, "How to Fix the 21st Century's Dirty Engine of Growth," Dec. 2012.

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



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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