Arch is the nation’s second largest coal producer, with a significant focus in West Virginia.
The developed and developing world must work together to address climate concerns

- Rapid increases in CO$_2$ emissions in emerging Asia underscore the need for global solutions
- China is now the largest emitter of CO$_2$ and the developing world has surpassed the OECD nations in total emissions

Source: World Energy Outlook 2013

*OECD = Organization for Economic Cooperation and Development
What’s driving this huge increase in GHG emissions in the developing world?

- Asia is developing rapidly, led by China
- Urbanization in China has just crossed over 50%, so more growth is coming
- China alone expects to add 300 million people to the middle class over the next 15 years
- Meanwhile, in other parts of the emerging world, 1.3 billion people lack any access to electricity
- 3 billion people lack clean cooking facilities
- The challenges of climate change and energy poverty are inextricably entwined
Coal has been the world’s fastest-growing major fuel source for more than a decade

Change in Global Energy Consumption between 2002 and 2012
(percent change based on millions of tonnes of oil equivalent)

- Coal: 55%
- Hydro: 39%
- Natural Gas: 31%
- Oil: 14%
- Nuclear: -8%

Source: BP Statistical Review of World Energy 2013
The build-out of coal-based capacity is continuing

New Coal-Fueled Generation Coming Online by 2017
- Capacity under construction, in GW, from 2013-2017

Online in 2013
- 133 GW
- 392 mm tonnes

Under construction*
- 288 GW
- 850 mm tonnes

Planned by 2017*
- 483 GW
- 1.4 bn tonnes

Sources: ACI and Platts International
*Includes capacity expected to come online in 2013
Coal consumption in Asia continues to climb, with other nations following China and India’s lead

- The IEA projects that coal consumption in Southeast Asia will triple by 2030
- Vietnam plans to add more than 30 GWs of coal-based capacity this decade
- Thailand’s energy agency expects power demand to double by 2030, and views coal as a lower cost and more secure option than LNG
- Japan’s coal use rose 15% in 2013, and two new coal plants are scheduled to come online soon
Global coal consumption is projected to continue to climb, despite relatively flat demand in the West

Source: EIA
Industrialization and urbanization are also lifting the demand for steel ... and thus met coal

World steel consumption is also projected to increase significantly during the remainder of the decade and beyond

Demand for met coal will be driven by increased utilization at existing steel plants and the projected build-out of new steel capacity

Sources: Consensus forecast of Wood Mackenzie, McKinsey, AME and CRU
In the U.S., the story is very different … with one third of all coal-based units expected to retire

- **Number of units**
  - Likely to Continue: 66%
  - Likely to Retire: 4%
  - Retired: 9%

- **Installed capacity**
  - Likely to Continue: 83%
  - Likely to Retire: 13%
  - Retired: 1%

- **Coal consumption in 2012**
  - Likely to Continue: 91%
  - Likely to Retire: 8%
  - Retired: 1%

Source: Ventyx, ACI
In total, we expect that 55 GWs of capacity will retire by 2018 ... and that Appalachia will be disproportionately affected.

Coal Consumption for Power Generation
(based on 2012 data)

- 750 million tons
- ~ 75 million tons

Percentage of Each Basin’s Total Supply that was Delivered to At-Risk Plants in 2012:
- Appalachia (Thermal): 16%
- Western Bit.: 12%
- Illinois Basin: 11%
- PRB: 8%
- Lignite: 2%

Sources: Wood Mackenzie, SNL and ACI
Energy markets are highly dynamic ... and thus there is great value in fuel diversity

<table>
<thead>
<tr>
<th>Period</th>
<th>Events</th>
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<tbody>
<tr>
<td>Late 1990s</td>
<td>• Natural gas plants in favor due to perceived “gas bubble”</td>
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<td>• Nuclear viewed as politically infeasible</td>
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<td></td>
<td>• Coal’s growth limited to higher utilization at existing base</td>
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<td>Early 2000s</td>
<td>• As natural gas prices rose, it fell out of favor</td>
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<td>• Coal became the fuel of choice, with 100 GW to be built</td>
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<td>• Nuclear remained on the sidelines</td>
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<td>Mid 2000s</td>
<td>• Climate concerns tempered coal’s growth</td>
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<td>• Natural gas viewed as too expensive and too volatile</td>
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<td></td>
<td>• Nuclear gained significant traction</td>
</tr>
<tr>
<td>Late 2000s</td>
<td>• Nuclear renaissance gave way to Great Recession</td>
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<td>• Shale gas emerged; natural gas back in the spotlight</td>
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<td></td>
<td>• Challenge of rapid renewables build-out became clear</td>
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<tr>
<td>Early 2010s</td>
<td>• Shale gas bubble hurts renewable build-out</td>
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<tr>
<td></td>
<td>• Fukushima disaster and high costs set back nuclear</td>
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<td></td>
<td>• Coal retirements begin; will sentiment change again?</td>
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</table>
The U.S. power industry has a highly successful record of air quality improvements on which to build.

**U.S. GDP (in 2005 $)**
- +210%

**Coal-Based Electricity Generation**
- +163%

**U.S. Population**
- +50%

**NO\textsubscript{x} Emissions**
- -49%

**SO\textsubscript{2} Emissions**
- -68%

**PM\textsubscript{10} Emissions**
- -75%

1970 to 2010
(percent change)

Sources: NMA, EPA, EIA

Emissions = Nitrogen Oxide (NO\textsubscript{x}), Sulfur Dioxide (SO\textsubscript{2}), Particulate Matter (PM\textsubscript{10})
We are confident we can achieve the same success with GHGs ... but it won’t happen overnight

- Each aspect of carbon capture, utilization and storage (CCUS) has been demonstrated, but not in an integrated system
- Two such plants – Kemper County and Boundary Dam 3 – are scheduled to come online during 2014
- As first-of-kind projects, they were subsidized ... and expensive
- Still, their start-up represents real progress – and provides further evidence that large-scale deployment is possible
The key to success is investment rather than an overly aggressive and premature regulatory regime

- EPA is requiring that any new coal plant built in the U.S. be equipped with CCUS
- There are 7,200 coal-based power units operating worldwide – none with CCUS
- Unachievable standards for coal plants will drive fuel-switching, not technology deployment
- Investment will spur far more progress than overly ambitious regulations
- To have this important technology available by mid-century, we need more investment, not less … and we need to start soon
The path to the future

• We cannot address climate concerns unilaterally ... and we cannot shrink our way to a low-carbon future

• There is no realistic path to a low-carbon future without a low-carbon fossil fuel solution

• Technology can and will provide that solution

• Investment is the key to moving technology forward ... not regulation

• CCUS is an essential mitigation tool, and we need to accelerate our efforts so that it is ready for large-scale deployment during the 2020s
Meeting the Climate Challenge

Deck S. Slone
Senior Vice President, Strategy and Public Policy

Charleston, West Virginia | December 17, 2013