THE ROLE OF COAL IN A CARBON CONSTRAINED FUTURE

Nikki Fisher, Coal Stewardship Manager, 16 April 2014
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1. Global Coal Picture
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Energy demand rises by over one-third in 2010-2035 in the New Policies Scenario

Driven by population growth, urbanisation, rising living standard and electrification

Source: IEA World Energy Outlook 2012
THERMAL COAL MARKET DRIVEN BY ASIAN GROWTH...

Primary energy demand in selected regions and the share of global growth in the new policies scenario (Mtoe)

China’s energy growth overshadows other markets

Source: IEA World Energy Outlook 2013
GLOBAL ENERGY DEMAND
Since the start of the 21st century, coal has dominated the global energy demand picture

In spite of global intentions to move away from coal, the growth in the use of coal for primary energy accounted for 47% of energy demand growth over 2001 – 2011

- 2% of the world’s population controls 52% of the world’s oil and 3% of the population controls 54% of the natural gas; 42% of the global population controls 50% of the coal.

Source: IEA World Energy Outlook 2012
World electricity demand predicted to grow by more than 52% to 2035

Even though gas gains market share, coal remains dominant fuel source

Coal provides excellent mechanism to participate in current and future energy markets.

THERMAL COAL DEMAND CONTINUES TO GROW

Fuel Mix in Electricity Generation by IEA Scenario (TWh)

World will continue to depend on coal as source of energy

Source: EIA, IEA and Wood Mackenzie Coal Market Service May 2012 and SALVA report
### DRIVER: POPULATION GROWTH AND URBANIZATION

#### World Population
- **Now:** 7 billion
- **By 2050:** 9 billion
- **By 2100:** 10.1 billion

#### Urbanization
- **3.3 billion people live in cities today.**
- **By 2035:** Increase by 60%

#### Countries with Urbanization below 50%
- China: 47%
- Indonesia: 44%
- India: 30%

#### Annual Rate of Change 2010-2015
- Canada: 1.1%
- USA: 1.2%
- Japan: 0.2%
- France: 1.0%
- Germany: 0.0%
- Russia: -0.2%
- S Korea: 0.6%
- Taiwan: N/A
- Brazil: 1.1%
- South Africa: 1.2%
- China: 2.3%
- Indonesia: 1.7%
- India: 2.4%

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Source: United Nations Population Division
GLOBAL ACCESS TO ENERGY

- 1.3 billion people globally do not have access to electricity
- Over 95% of those without electricity are in developing Asia or sub-Saharan Africa
- 1.8 million households in South Africa are not connected to the national grid

Source: IEA World Energy Outlook 2011
COAL: KEY TO SA’S ECONOMY
In 2012, South Africa’s saleable coal production was 258Mt

- Coal is one of the top 2 components of the SA mining industry

  Top 3 commodities by total sales value

<table>
<thead>
<tr>
<th>ZAR billions</th>
<th>Coal</th>
<th>Platinum</th>
<th>Gold</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>65.4</td>
<td>58.0</td>
<td>51.2</td>
</tr>
<tr>
<td>2010</td>
<td>71.1</td>
<td>73.8</td>
<td>55.9</td>
</tr>
<tr>
<td>2011</td>
<td>87.8</td>
<td>83.9</td>
<td>65.8</td>
</tr>
<tr>
<td>2012</td>
<td>96.1</td>
<td>69.2</td>
<td>76.8</td>
</tr>
</tbody>
</table>

- Coal employed some 78,000 people & paid ZAR16.1 billion in wages

- The Coal Resources and Reserves Study of SA (CRRSA) – not yet released but in final consultation stages – suggests that SA still has >60Bt* of recoverable coal reserves

- South Africa is the 24th largest economy in the world – but is the 12th-largest contributor of GHG’s
  - Further coal utilization must be balanced against SA’s carbon reduction pledges

Source: South African Chamber of Mines, Department of Mineral Resources

* Note: Not per SAMREC Code
**FUTURE OF COAL IN SOUTH AFRICA**

Integrated Resource Plan for South Africa 2010 to 2030 promulgated 6 May 2011

Department of Energy’s IRP “Policy-Adjusted” generation scenario approved: a middle ground between “Low Carbon” & “Low Cost” strategies

Much of the new coal capacity (beyond the 10GW under construction) is planned for late-2020’s. **Can the aggressive renewable & nuclear programme be delivered?**

A carbon tax on Scope 1 emissions is being proposed by National Treasury

<table>
<thead>
<tr>
<th>Energy source</th>
<th>Share of total new GW</th>
<th>Total additional new capacity (without committed) until 2030 in GW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>15%</td>
<td>6.3, 9.6, 2.6, 2.4, 3.9, 8.4, 8.4, 1.0, 1.0</td>
</tr>
<tr>
<td>Nuclear</td>
<td>23%</td>
<td>9.6, 0.0, 2.1, 2.4, 2.4, 2.4</td>
</tr>
<tr>
<td>Hydro</td>
<td>6%</td>
<td>2.6, 0.0, 0.0, 0.0, 0.0, 0.0</td>
</tr>
<tr>
<td>Gas - CCGT</td>
<td>6%</td>
<td>2.4, 0.0, 0.0, 0.0, 0.0, 0.0</td>
</tr>
<tr>
<td>Peak - OCGT</td>
<td>9%</td>
<td>3.9, 2.4, 2.4, 2.4, 2.4</td>
</tr>
<tr>
<td>Renewables</td>
<td>42%</td>
<td>17.8, 8.4, 8.4, 1.0, 1.0</td>
</tr>
</tbody>
</table>

**Total**

<table>
<thead>
<tr>
<th>Energy share</th>
<th>In 2010</th>
<th>In 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>65%</td>
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<tr>
<td>Nuclear</td>
<td>20%</td>
<td>5%</td>
</tr>
<tr>
<td>Hydro</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Gas - CCGT</td>
<td>&lt;0.1%</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Peak - OCGT</td>
<td>9%</td>
<td>1%</td>
</tr>
<tr>
<td>Renewables</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Source:** IRP2010
"21st Century Coal" provides a technology path to solving the energy security-climate change nexus.

COAL IS ESSENTIAL FOR BASE LOAD SUPPLY AND AS BACKUP FOR INTERMITTENT TECHNOLOGIES

Mitigating the impacts of intermittent energy supply requires widely interconnected, significant adjoining electricity networks

Source: European Commission
SUPPLY SIDE EFFICIENCY

Efficiency plays a major role in carbon emission abatement. Improving coal power plant efficiency from the current global average of 28% could reduce carbon emissions by up to a third.

Source: IEA, 2008
CARBON CAPTURE AND STORAGE (CCS)
Where does it fit in and how does it contribute?

The cost of meeting the 2 degree scenario would increase by a further 40% if CCS is not available, with a total extra cost of USD 2 trillion over 40 years.

CCS is cost comparable with other low carbon technologies.

Source: IEA CCS Roadmap. IEA Energy Technology Perspectives (2012) and Global Carbon Capture and Storage Institute
21ST CENTURY COAL TECHNOLOGY

**FUTUREGEN**

- Near-zero emission, commercial scale coal-fired power plant in Illinois, USA
- Retrofit of an existing power station with oxy-combustion technology for CO₂ capture
- CO₂ to be piped 48km and stored 1.3 million tons CO₂ per annum (more than 90%) in a deep saline aquifer
- Will create 1,610 direct and indirect Illinois jobs at peak-construction while maintaining an average of 620 well-paying jobs for the next 20 years
- The project also will generate more than $243 million in income and sales tax revenues during the initial 20 years of operations

**ISOGO THERMAL POWER STATION**

- Cleanest coal fired power station in the world
- Gross thermal efficiency of 45% - reducing carbon emissions by 17% from older units operating at 40% efficiency.
- CO₂ emissions of 0.83 kg CO₂/kWh
- Multi-pollutant control technology removes
  - 92% nitrous oxides
  - 98% sulphur
  - 90% elemental and oxides forms of mercury
- Electrostatic precipitators remove 99.9% of soot and dust

*Images of FUTUREGEN and ISOGO THERMAL POWER STATION*
The future of coal rests on a foundation of several elements, including an uncompromising commitment to safety, modern cutting-edge mining techniques, world-class land restoration practices and a technology path to Near-Zero Emissions.

THANK YOU