Powering economies with 21st Century coal technology

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Coal has fuelled the 21st Century so far and remains an important part of the global energy mix.
World energy demand is growing at a rapid pace and coal will still have a big role.

- World energy demand is set to grow significantly, in any scenario.

- Even with the IEA’s ambitious growth projection for renewables and significant international climate action, coal will still be a major source of electricity in 2040.

Source: IEA, WEO 2014
20% of the world population has no access to modern energy

- 1.3 billion people in the world who live without access to electricity
- 2.6 billion who rely on traditional fuels for cooking.

Coal is a key energy resource in the ongoing global fight to address energy poverty.

- As the world's most abundant and affordable energy fuel, coal has a role to play in delivering universal energy access.

- China provides an excellent example of an electrification strategy based on coal, with a 400% increase in China's coal consumption and 660 million people lifted out of poverty since 1980s.

Additional on-grid electricity generation (Energy for All Case compared with the New Policies Scenario, 2030.

![Pie chart showing on-grid generation (368 TWh) with 50% Coal, 13% Oil and Gas, 3% Nuclear, 14% Hydro, 5% Wind, 5% Solar, 10% Other renewables.]

Driven by Asia coal power generation capacity will continue to grow

Asian share of global coal power generation capacity
- 2000 – 38%
- 2015 – 69%
- 2040 – 77%

Will require an additional 1.8 billion tonnes per annum of coal
China continues to grow, with coal fired generation increasing at a slower growth rate, though still 50% of mix

- China's transformative growth has been fuelled by coal and over the last three decades
  - 660 million people out of poverty
  - Steel production multiplied by 18
  - Cement production multiplied by almost 14
  - Connected 99% of its population to the grid

- Electricity generation from coal will be 45% higher in 2040, despite its share of generation reducing from 75% to 52%

- Non-hydro renewables are expected to increase 1200% over the same period (25% of world generation)

Source: IEA, WEO 2014, New Policies Scenario
Large-scale power generation will be a critical enabler of growth in India

- Electricity demand in India is expected to average 4.4% pa over the next 25 years.

- While coal generation capacity more than doubles, renewables are required to increase exponentially (non-hydro renewables by over 10 times) to meet demand.

- IEA indicates that maintaining an adequate electricity supply represents a significant investment challenge requiring $2 trillion (in 2013 dollars).

Source: IEA, WEO 2014, New Policies Scenario
Climate change is a huge global challenge – we’re a long way from where we need to:

- To achieve 2-degree goal will require massive decarbonisation of the energy system
- CCS on fossil fuels will be essential to making that change happen
- Using only renewable energy technologies requires a scale of decarbonisation never seen in history

**Global trends in energy intensity, past, and projected**

![Graph showing energy intensity reduction](image)

- Energy intensity reduction needed with CCS & nuclear
- Energy intensity reduction needed without CCS & nuclear, i.e. REN only

Technological change is slow – so we should be using every tool in our arsenal

- Historical range of energy technology deployment is dramatically below what would be required to achieve 2-degree target
- Is it therefore sensible to rule out any technology option?
- High efficiency coal and CCS must be included to maximise our chance of succeeding

*All capacity addition rates normalized by constant dollar global GDP.

Fuel switching to gas isn’t the answer

- IEA CCC has examined the climate implications of coal to gas substitution in power generation.

- The study takes into account the GHG's from CH4 upstream, CO2 upstream and CO2 smokestack.

- The study indicates that the current leakage from the natural gas (NG) system (e.g., pipelines) is likely to be in the range of 2-4%.

- In the range of 2.9-3.6% leakage for new CCGT vs SC coal, the total emissions are the same.

Figure 25 Fuel-cycle GHG emissions (kg) from 1 MWh of electricity produced (Busch and Gamon, 2014)

Cleaner coal technologies have addressed environmental challenges

- Clean coal technologies, such as electrostatic precipitators, fabric filters, selective catalytic reduction systems, wet and dry scrubbers, sorbents and activated carbon injection can reduce the emissions of pollutants from coal combustion by 90% to 99.9%.

- In the USA the emissions of NOx, SOx and PM were reduced by 82 to 96% since 1970, while coal consumption increased by 146%
Efficiency improvements can significantly contribute to CO2 emission reductions

- The most important near-term action to reduce CO2 emissions is to increase the efficiency of coal-fired power plants.
- 1% increase LHV efficiency = 2–3% points decrease in CO2 emissions.
- Moving the current average global efficiency rate of coal-fired power plants from 33 to 40% by deploying more advanced technology could cut 2 gigatonnes of CO2 emissions (equivalent of India’s annual CO2 emissions).

Source: VGB PowerTech 2013, WCA
Cleaner coal is real but needs more action

- Of 1,856 GW installed global coal-fired capacity only 10% is Ultra Super-Critical
- Japan and China have been the most active in building USC plants
- J-Power upgraded their 1967 sub-critical Isogo 38% efficient coal-fired power plant to an USC 43% efficiency plant with SOx, NOx, PM reduced to less than 1/3 of previous levels
- China’s Ninghai plant has a capacity of 4,400MW and China is relying on these larger, advanced units for dispatch to displace higher emission from older, less efficient power stations
- The units have integrated advanced air quality control systems, yielding non-carbon air emissions well below China’s latest more stringent standards, and also below comparable standards in North America and Europe
The potential impact of HELE is significant in a global context.

<table>
<thead>
<tr>
<th>Policy / Action</th>
<th>Cumulative emissions</th>
<th>Period</th>
<th>Annual emissions*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montreal protocol</td>
<td>135.0bn</td>
<td>1989-2013</td>
<td>5.6bn</td>
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<tr>
<td>Hydropower worldwide</td>
<td>2.8bn</td>
<td>2010</td>
<td>2.8bn</td>
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<tr>
<td>Nuclear power worldwide</td>
<td>2.2bn</td>
<td>2010</td>
<td>2.2bn</td>
</tr>
<tr>
<td>Increase average global efficiency of coal-fired power plants to 40%</td>
<td>2bn</td>
<td></td>
<td></td>
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<tr>
<td>China one-child policy</td>
<td>1.3bn</td>
<td>2005</td>
<td>1.3bn</td>
</tr>
<tr>
<td>Other renewables worldwide</td>
<td>600m</td>
<td>2010</td>
<td>600m</td>
</tr>
<tr>
<td>US vehicle emissions &amp; fuel economy standards†</td>
<td>6.0bn</td>
<td>2012-2025</td>
<td>460m</td>
</tr>
<tr>
<td>Brazil forest preservation</td>
<td>3.2bn</td>
<td>2005-2013</td>
<td>400m</td>
</tr>
<tr>
<td>India land-use change</td>
<td>177m</td>
<td>2007</td>
<td>177m</td>
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<tr>
<td>Clean Development Mechanism</td>
<td>1.5bn</td>
<td>2004-2014</td>
<td>150m</td>
</tr>
<tr>
<td>Collapse of USSR</td>
<td>709m</td>
<td>1992-1998</td>
<td>118m</td>
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<tr>
<td>Global Environment Facility</td>
<td>2.3bn</td>
<td>1991-2014</td>
<td>100m</td>
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<tr>
<td>EU energy efficiency</td>
<td>230m</td>
<td>2008-2012</td>
<td>58m</td>
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<tr>
<td>EU renewables</td>
<td>117m</td>
<td>2008-2012</td>
<td>29m</td>
</tr>
</tbody>
</table>

* Annual emissions are cumulative emissions divided by the relevant period.
† The annual figure for the collapse of the USSR refers to the years 1992-1998.
‡ Cars and light trucks

Comparative climate actions

Initiatives needed to cut 2 Gt of CO₂ emissions

- Run the **EU ETS** for 53 years
- Run the **Kyoto Protocol** 3 times
- Multiply the world’s **current solar power capacity** by 195
- Increase the **efficiency of all coal power plants** from 33% to 40%
WCA proposes the PACE concept to support HELE

A Global Platform for Accelerating Coal Efficiency

- International platform to help drive deployment of HELE technologies in developing and emerging economies
- Public private partnership
- Currently seeking partners to help build an initial alliance
CCS is critical to global climate objectives

- CCS technology can reduce GHG emissions from coal-fired power plants by up to 90%.
- CCS is expected to deliver 14% of cumulative GHG emissions cuts through to 2050. It is therefore a key low-carbon technology.
- The world's first large scale integrated CCS project capturing CO2 from a coal-fired power plant – Sask Power's Boundary Dam – has just started full scale operation at the end of September 2014.

Contributions of different technologies to annual emissions reductions

Source: IEA Energy Technology Perspectives 2014
Abating CO2 with CCS on coal is cost effective

Avoided cost of CO2 (2014 US$)

Source: Global CCS Institute
Coal+CCS will be competitive with other low emission technologies

Levelised cost of electricity (2014 US$)

Source: Global CCS Institute
CCS is real, and is happening now

- The world’s first application of CCS at large scale in the power sector became operational in October 2014, at the Boundary Dam power station in Canada (1 Mtpa CO2 capture)
- An upgrade of a 1960’s coal unit chosen by Saskpower over gas and renewables
- Two more large scale applications of CCS in power will come on line in 2016 in the US
  - Kemper County Energy Facility (3 Mtpa, Mississippi)
  - Petra Nova Carbon Capture Project (1.4 Mtpa, Texas)
- Large-scale application of CCS will become a reality in iron and steel in 2016 at the Abu Dhabi CCS Project (0.8 Mtpa)
- A further 14 projects are in advanced planning (FEED)
Low emission coal technology has been slow to progress – we need urgent and improved action.

**Strong policy drives investment**

Clean energy investment* between 2004-2013 (USD):

- CCS: 20 billion
- All clean energy: 1929 billion

* includes technology development, projects, M&A. Source: BNEF.
COP21 provides an opportunity to drive realistic climate action

The World Coal Association calls for:

1. Recognition of the CO2 mitigation potential of high-efficiency, low emission (HELE) coal-fueled power generation and the absolute necessity of international financial support for such projects.

2. Recognition of the imperative of carbon capture, utilisation and storage (CCUS) for meeting global climate objectives and support increased international action and financial support to deploy this technology.

3. CCUS technologies be given policy parity with other low emission energy technologies in international climate mechanisms and national policy settings.