The new global dynamics for coal

Liam McHugh
Policy Manager
As electricity changes, coal retains an edge

Global primary energy demand under the IEA New Policies Scenario

Today coal is found in 70 countries and actively mined in 50.

At current rates of consumption, the IEA forecasts that coal will last 114 years, compared to 53 years for gas and only 51 years for oil.

1.2 billion people live without access to electricity.
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- 1.2 billion people worldwide live without access to electricity
- 2.7 billion rely on traditional fuels for cooking

People without access to modern energy services by region

Coal is key in addressing global energy poverty

Additional on-grid electricity generation by fuel in the “Energy for All Case” compared with the New Policies Scenario, 2030

- Coal: 50%
- Oil and Gas: 14%
- Nuclear: 13%
- Hydro: 10%
- Solar: 5%
- Wind: 5%
- Other Renewables: 3%

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

Coal generation capacity more than doubles, while renewables also increase significantly to meet demand.

IEA indicates that maintaining an adequate electricity supply represents a significant investment challenge requiring $2 trillion (in 2013 dollars).
The share of coal in power generation rises from 32% to 50%.

Renewables-based electricity generation increases three and half times from today to 2040 (481 TWh).

IEA highlights $2.4 trillion investment is required over the period to 2040. This represents around 5% of the global total, or one-third of China’s investment.

... and will be critical in powering up SE Asia.
China’s electricity demand growth will be around 4.8% to 2020, then decline to around 2% through to 2040.

Electricity generation from coal will be 4.3% higher in 2040, despite its share of generation reducing from 73% to 43%.

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

Coal will be critical to China for decades.
Coal, not gas, leads the charge in Asia...

Coal and gas-fired power investment in Asian markets (2015)

Source: IEA World Energy Outlook 2016
... because its costs are far lower

Infrastructure investment cost for a 1 GW power plant in Asia

So the global coal fleet is at its youngest in decades

Age of coal plants globally

The Paris Agreement includes low emissions coal
New technology dramatically reduces CO2

For every 1% efficiency improvement, we get 2-3% reduction in CO₂ emissions.
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.

Efficiency improvements can significantly contribute to CO2 emission reductions.
Cleaner coal is real but needs more action

- 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 Waigaoqiao plant has a capacity of 5000MW 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.
WCA proposes the PACE concept to support HELE

- 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
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>
</tr>
<tr>
<td>Hydropower worldwide</td>
<td>2.8bn</td>
<td>2010</td>
<td>2.8bn</td>
</tr>
<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>
</tr>
<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>
</tr>
<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>
</tr>
<tr>
<td>Global Environment Facility</td>
<td>2.3bn</td>
<td>1991-2014</td>
<td>100m</td>
</tr>
<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>
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</tbody>
</table>

* Annual emissions are cumulative emissions divided by the relevant period.
† The estimate for the current emissions avoided under the Montreal protocol is eight billion tonnes of CO₂e.
† Cars and light trucks

Sources: The Economist 2014 and International Energy Agency 2013
CCS needs policy parity

Fluctuating policy and political support for CCS

Source: IEA (2016), 20 years of Carbon Capture and Storage: Accelerating Future Deployment. Figure adapted from SBC Energy Institute (2016), Low Carbon Energy Technologies Fact Book Update: Carbon Capture and Storage at a Crossroads.
There are real challenges to high renewable penetration.
There are real challenges to high renewable penetration.
ASEAN’s Energy Equation

- ‘Coal and Cleaner Coal Technologies’ (CCT) were identified as a key programme area in APAEC 2016 – 2025
- ‘ASEAN Energy Equation’ provides a comprehensive analysis of the energy security and sustainable development opportunities that CCT provide
Cleaner coal is the lowest cost option among the low-carbon technologies.

**ASEAN Average**

2020 Commercial Operation

**ASEAN Average**

2035 (No CO₂ Price Assumed)

IEA expects long-term landed LNG price to increase over time.
Improving coal efficiency delivers cost benefits locally and emissions reductions globally

- Promoting HELE deployment across ASEAN would result in significant carbon emissions reduction to global benefit.
- Shifting the region’s forecast coal capacity in 2035 from the current mix to ultra-supercritical would reduce cumulative emissions by 1.3 billion tonnes.
Mobilising finance will be an important factor in realising this outcome...

<table>
<thead>
<tr>
<th>Scenario Description</th>
<th>Mix per current pipeline</th>
<th>Shift to Supercritical</th>
<th>Shift to Ultra-supercritical</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Total installed coal capacity by 2035 based on IEA SEA-E0 projections with linear extrapolation between current pipeline of projects as reported by the Platts WEPD (percentage of subcritical capacity through 2035 based on current pipeline)</td>
<td>Shift capacity from subcritical to supercritical except plant that are under construction or planned subcritical plant with capacity lower than 300 MW</td>
<td>Shift all capacity from supercritical in the previous scenario to ultra-supercritical</td>
</tr>
</tbody>
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<th>Capacity Mix³</th>
<th>USC</th>
<th>SC</th>
<th>SubC</th>
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<td>GW CAPACITY</td>
<td>15</td>
<td>44</td>
<td>63</td>
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<td>GW CAPACITY</td>
<td>15</td>
<td>103</td>
<td>4</td>
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<th>SC</th>
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<tr>
<td>GW CAPACITY</td>
<td>4</td>
<td>113</td>
<td>4</td>
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<tr>
<th>NPV⁴ Capital Costs⁵ ($ Billion)</th>
<th>$89 Billion</th>
<th>$96 Billion</th>
<th>$108 Billion</th>
</tr>
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<tr>
<td>from 2016 through 2040</td>
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Additional $19 billion required to shift to ultra-supercritical

<table>
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<tr>
<th>CO₂ Emissions (tCO₂)</th>
<th>8.9 Billion</th>
<th>8.1 Billion</th>
<th>7.5 Billion</th>
</tr>
</thead>
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<tr>
<td>(Cumulative from 2016 through 2040, undiscouted)</td>
<td></td>
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Additional funding can reduce carbon emissions by 1.3 billion tons
...The benefits are significant

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Capacity mix¹</th>
<th>CO₂ emissions (tCO₂) (over 40 years)</th>
<th>CO₂ abated equivalent to</th>
</tr>
</thead>
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<tr>
<td>Mix per development pipeline</td>
<td>USC 15, SC 44, SubC 63</td>
<td>22.8 Billion</td>
<td>Subcritical plant closure²</td>
</tr>
<tr>
<td>Shift to Supercritical</td>
<td>USC 15, SC 103, SubC 4</td>
<td>20.8 Billion</td>
<td>20</td>
</tr>
<tr>
<td>Shift to Ultra-Supercritical</td>
<td>USC 4, SC 4, SubC 4</td>
<td>19.5 Billion</td>
<td>32</td>
</tr>
</tbody>
</table>

¹ Capacity mix in GW capacity
² Subcritical plant closure
³ Number of new wind turbines
⁴ Cars removed from the road
Investment to ensure an efficient coal fleet in Southeast Asia is vital for global climate ambitions.

Enhanced investment in coal to improve efficiency is arguably one the most effective mitigation actions available.
WCA encourages ASEAN Member States to adopt ‘ASEAN’s Energy Equation’s Call to Action’

1. Statement emphasising continued commitment to the deployment of cleaner coal technologies

2. With necessary support from partners, member states commit to enhanced action, ultimately leading to a pledge to end the use of subcritical coal (where feasible)

3. Calling on the international community to provide support for cleaner coal technology deployment