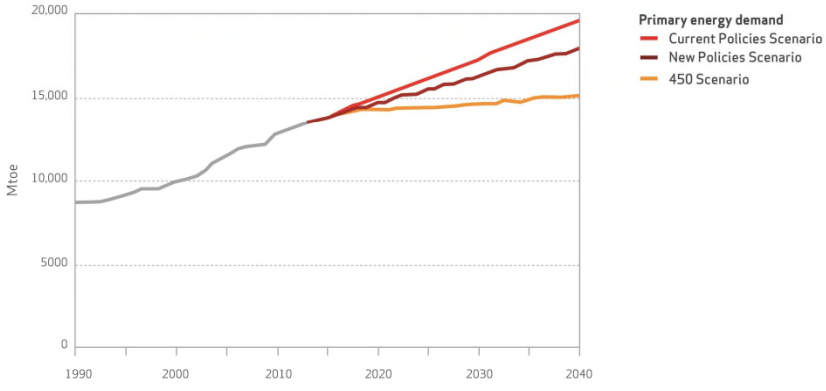
What role for coal after COP21?

Benjamin Sporton
Chief Executive

World energy demand is growing at a rapid pace

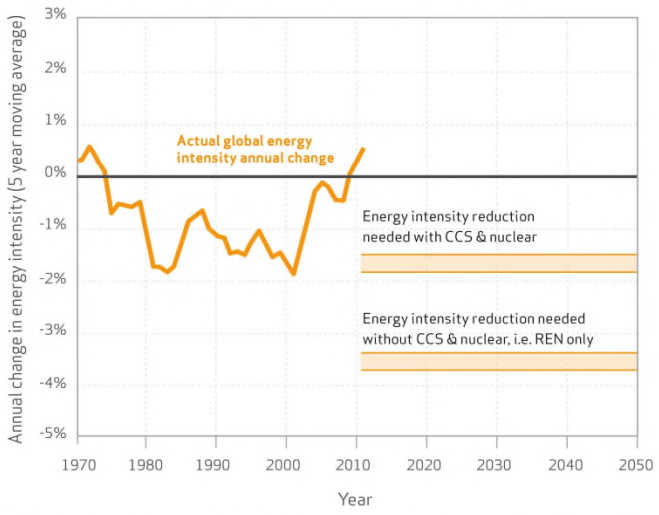
World total primary energy demand by scenario



Source: IEA, WEO 2015

Decarbonisation at the rate needed for climate targets presents a major challenge

Global trends in energy intensity, past, and projected



Source: Loftus Peter J., Cohen Armond M., Long Jane C. S., Jenkins Jesse D., A critical review of global decarbonization scenarios: what do they tell us about feasibility?. WIREs Climate Change 2015, Volume 6, Issue 1, pages 93-112, DOI: 10.1002/UCC.324

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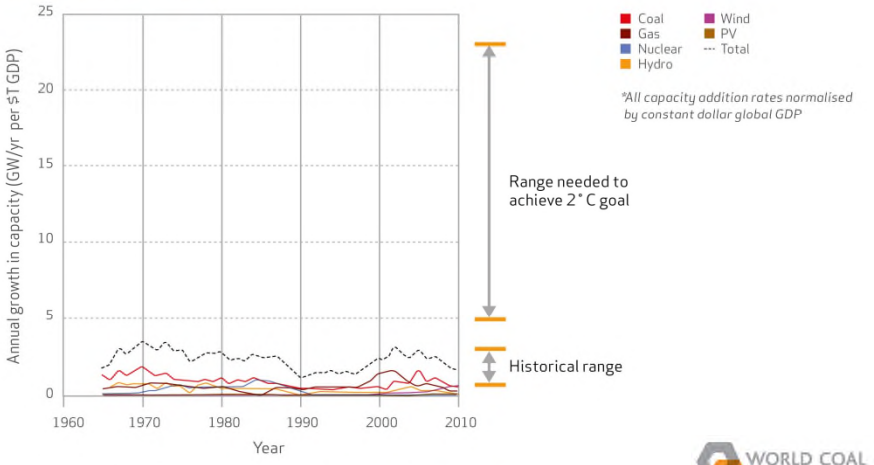
There are no easy solutions to the climate challenge, technological change is difficult

Worldwide normalised capacity addition rates of total power system capacity and key power generation technologies since 1965 and ranges of normalised capacity additions for scenarios reviewed



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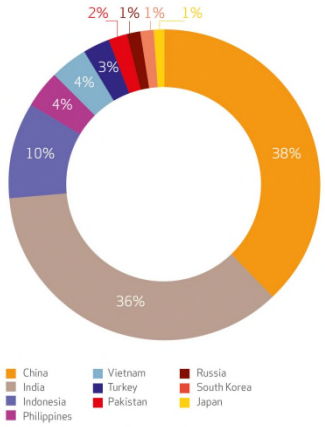
Current coal plant build is significant

- Globally there are 510 coal-fired power plant units under construction, with a further 1,874 planned, a total of 2,384
- China, India, Indonesia dominate making up 71% of the total
- Philippines, Vietnam, Turkey and Pakistan bring the total up to 81%
- Europe and North America play a very small role

Top 10 countries – Coal Fired Power Station Build



Source: Platts Database

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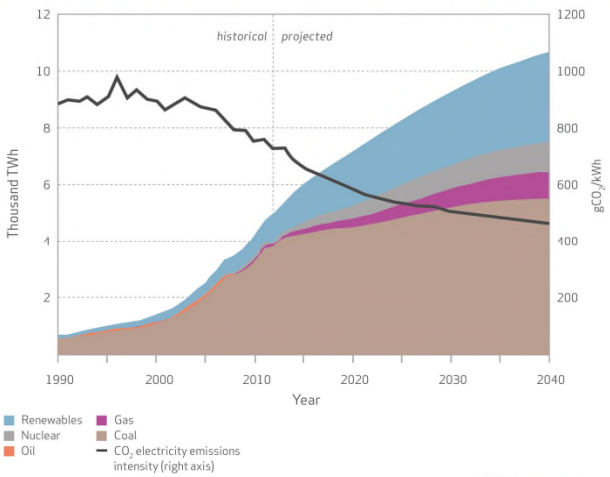
Despite rumours, coal isn't going away in China

- 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 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)

China electricity generation by source and CO_2 intensity in the New Policies Scenario



Source: IEA, WEO 2014

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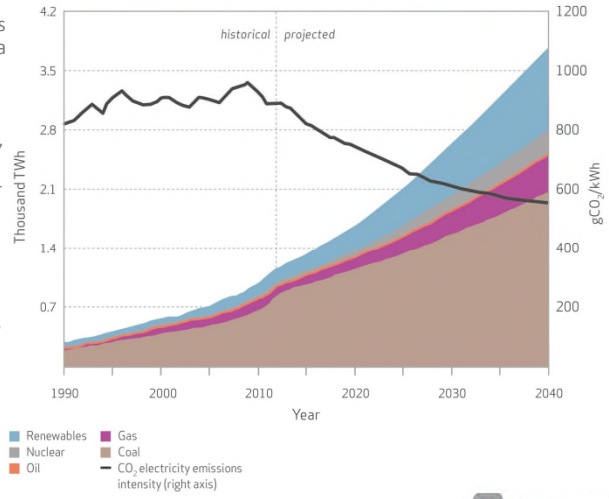
Large-scale power generation will be a critical enabler of growth in India

- 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 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)

India's electricity generation by source and CO_2 intensity in the New Policies Scenario



Source: IEA, WEO 2014

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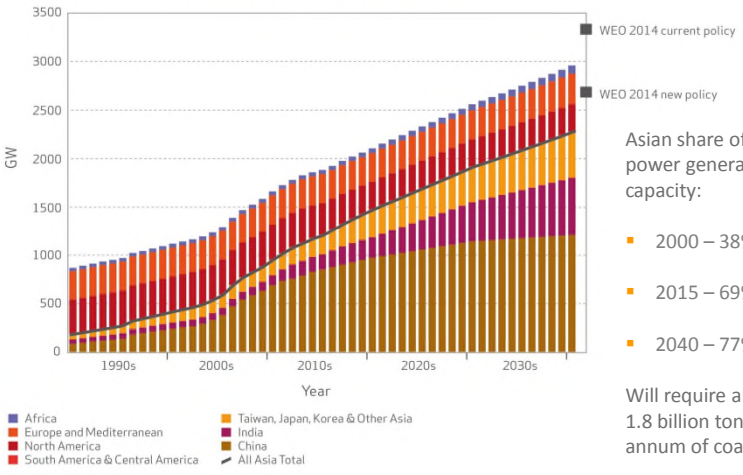
Driven by Asia, coal power generation capacity will continue to grow

Installed Coal Generation Capacity by Country/Region



Source: World Coal Association analysis

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

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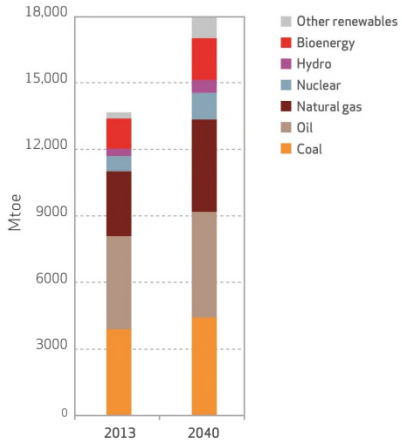
Coal will continue to play a major role

Primary energy demand by fuel in the New Policies 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 2015

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Fuel switching to gas isn't the answer

- The IEA CCC has examined the climate implications of coal to gas substitution in power generation
- The study takes in 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 (eg 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

Coal versus gas – efficiency and utilisation

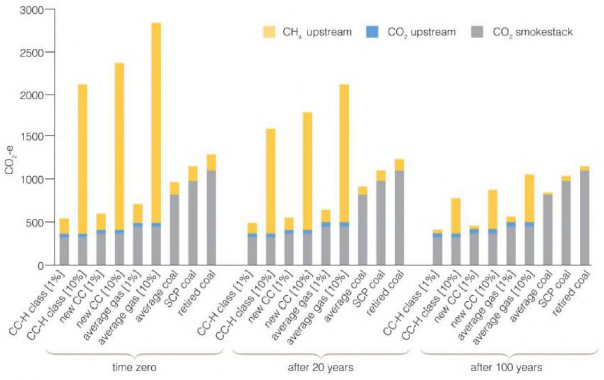

Figure 25 Fuel-cycle GHG emissions (kg) from 1 MWh of electricity produced (Busch and Gamon, 2014)

Source: IEA CCC Report "Climate implications of coal –to-gas substitution in power generation" Apr 2015

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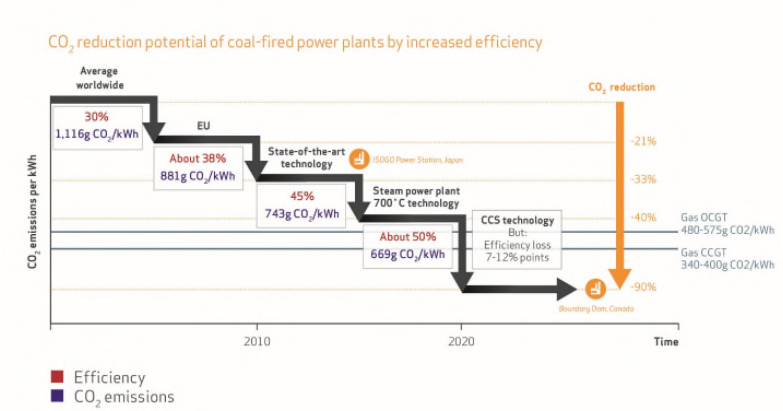
Efficiency improvements can significantly contribute to CO2 emission reductions



- 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

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Technology choice has significant CO2 implications

The environmental benefits of deploying cleaner coal technology in India

Scenario	Capacity mix	CO_2 emissions (tCO_2) (over 40 years)	CO_2 abated equivalent to		
			Subcritical plant closure	Number of new wind turbines	Cars removed from the road
Mix per development pipeline	USC 6, SC 167, SubC 118	84 Billion			
Shift to Supercritical	USC 6, SC 286, SubC 0	80 Billion	28	26,000	200 million
Shift to Ultra Supercritical	USC 292, SC 0, SubC 0	73 Billion	69	65,000	500 million

0 100 200 300 400
GW capacity

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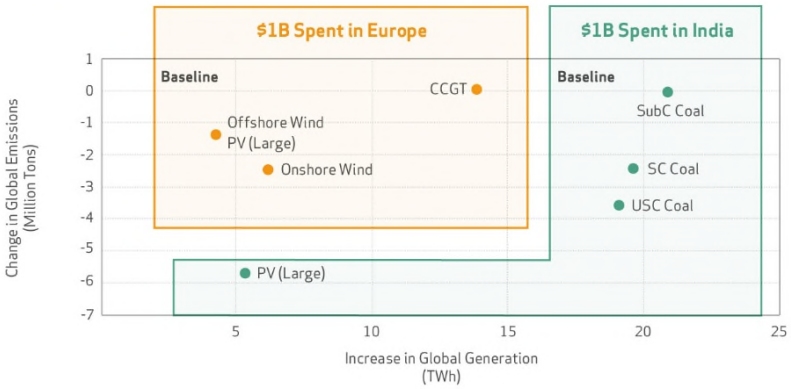
HELE technology supports economic and environmental objectives

Deploying cleaner coal technology promotes energy access, while managing emissions of carbon dioxide



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HELE technology 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

Japan: Isogo Power Station – Ultra Supercritical Technology (Courtesy of J – Power)

China: Ninghai Power Station, Zhejiang Province – 4,400MW consisting of four 600MW SC (2004) and two 1,000MW USC (2009)

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HELE has a big role in many INDCs

Implementing INDCs will be a challenge

A Global Platform for Accelerating Coal Efficiency

- International platform to help drive deployment of HELE technologies in developing and emerging economies
- Public private partnership to overcome financial, technical and regulatory barriers
- Currently seeking partners to help build an initial alliance

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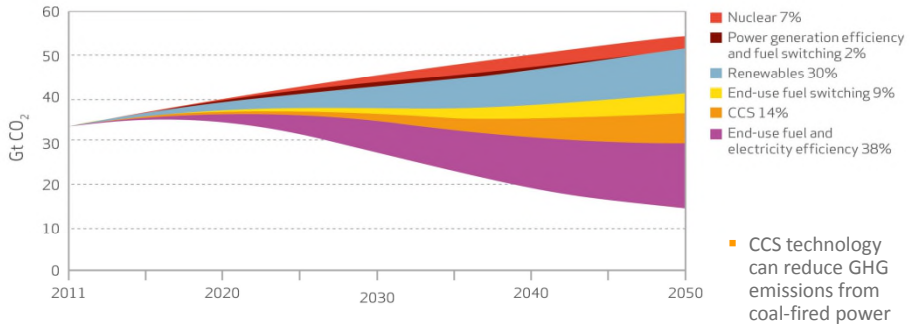
CCS is critical to global climate objectives

Contributions of different technologies to annual emissions reductions



Source: IEA Energy Technology Perspectives 2014

- 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

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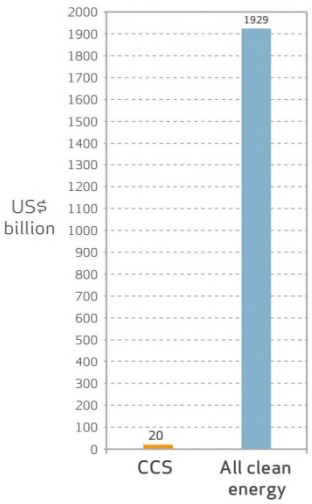
Why CCS has been slow to progress

Clean energy investment* between 2004 – 2013 (billion US$)

CCS: $20 billion

All clean energy: $1929 billion



1%

*includes technology development, projects, M&A

Source: IEA

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CCS is real, and 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)

- Boundary Dam, Saskatchewan, Canada
- Coal-fired 110MW CCS 1Mtpa plant operational October 2014
- $1.4Bn Government and Saskatchewan Power Co partnership

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The WCA view

- We must recognise that coal is an important driver of affordable, reliable energy to support economic development and competitiveness
- Coal plays a major role in industrialising and urbanising economies
- In any scenario coal is still going to play a major role in the world's energy mix – especially across Asia
- We can significantly reduce emissions from coal with commercially available technology today – we should encourage and support deployment of HELE technologies in preference of less efficient technologies
- More public support is needed to facilitate increased commercial demonstration of CCS to drive costs down so that we can begin a transition toward near-zero emission fossil fuels

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