"Clean Coal" Technology

What is "clean coal"?

Coal is a highly polluting energy source. From mine to sky, it contaminates every step of the way. From acid drainage from coal mines polluting rivers and streams, to the release of cancer-causing dioxins and other toxins when it is burned, as well as pollution-forming gases and fine particulates that wreak havoc on human health, coal is a dirty business.

It is a major contributor to climate change – the biggest environmental threat we face. It is the most carbon-intensive fossil fuel, emitting 72% more carbon dioxide (the main driver of climate change) per unit of energy than gas.[1]

Mercury is a particular problem. According to the United Nations Environment Programme (UNEP), mercury and its compounds are highly toxic and pose a 'global environmental threat to humans and wildlife.'[2] Coal-fired power and heat production are the largest single source of atmospheric mercury emissions.[3] There are no commercially available technologies to prevent mercury emissions from coal-fired power plants.[4]

"Clean coal" is the industry's attempt to "clean up" its dirty image – the industry's greenwash buzzword. It is not a new type of coal. "Clean coal" technology (CCT) refers to technologies intended to reduce pollution. But no coal-fired power plants are truly 'clean'.

"Clean coal" methods only move pollutants from one waste stream to another which are then still released into the environment. Any time coal is burnt, contaminants are released and they have to go somewhere. They can be released via the flu ash, the gaseous air emissions, water outflow or the ash left at the bottom after burning. Ultimately they still end up polluting the environment.

Despite over 10 years of research and $5.2 billion of investment in the US alone[5], scientists are still unable to make coal clean. "Clean coal" technologies are expensive and do nothing to mitigate the environmental effects of coal mining or the devastating effects of global warming. Furthermore, clean coal research risks diverting investment away from renewable energy, which is available to reduce greenhouse gas emissions now.

The first CCT programs were set up in the late 1980s in response to concerns over acid rain. The programs focused on reducing emissions of sulphur dioxide (SO_2) and oxides of nitrogen (NO_X), the primary causes of acid rain.[6] Now the elusive promise of "clean coal" technology is being used to promote coal as an energy source in New Zealand.

A price worth paying?

Many of the 'clean coal' technologies that industry is currently touting are still in the development stage and will take hundreds of millions, if not billions, of dollars and many more years before they are commercially available. "Clean coal" technologies are also extremely expensive in terms of day to day running costs. The US Energy Information Administration (EIA) estimates the capital costs of a typical IGCC plant (an experimental low-emission coal power station) to be US$1,383/kW, $2,088/kW with carbon sequestration. This compares with US$1,015/kW for a typical wind farm.[7]

“Clean Coal” Technologies

“Clean coal” technologies fall into four main categories coal washing, pollution controls for existing plants, efficient combustion technologies and experimental carbon capture and storage.

1) Coal washing

Lowers the level of sulphur and minerals in the coal. [11] Coal is not generally washed in New Zealand, although Solid Energy has a coal washing facility near its Spring Creek Mine. It is also trialling coal washing technologies using its high-sulphur Reefton coal.[12]

2) Pollution Controls for Existing Power Plants

Particulate emissions – can be reduced by *Electrostatic Precipitators* (ESPs) and *fabric filters*. ESPs are most widely used. Flue gases are passed between collecting plates. These attract particles using an electrical charge.[13]

NO_X emissions – can be reduced by *Low-NO_X Burners (LNB).* These reduce the formation of NO_X by controlling the flame temperature and the chemical environment in which the coal combusts.[14] *Selective Catalytic or Non-Catalytic Reduction (SCR/SNCR)* are expensive and less widely used.[15]

SO_2 emissions - can be reduced by *Flue Gas Desulpurisation (FGD).* Wet FGD, or wet scrubbing, is most common and absorbs SO_2 using a sulphur absorbing chemical (sorbent), such as lime.[16]

Trace elements emissions – these include mercury, cadmium and arsenic. Some emissions can be reduced by particulate controls, fluidised bed combustion and FGD equipment.[17] *Activated Carbon Injection* is being trialled to remove mercury.[18]

3) Efficient Combustion Technologies

Supercritical Pulverised Coal Combustion (PCC) - uses high pressures and temperatures. This can increase the thermal efficiency of the plant from 35% to 45%. This reduces emissions as less coal is used.[19]

Fluidised Bed Coal Combustion (FBC) - allows coal combustion at relatively low temperatures, which reduces NO_X formation. A sorbent is used to absorb sulphur.[20]

Coal gasification - coal is reacted with steam and air or oxygen under high temperatures and pressures to form syngas (mostly carbon monoxide and hydrogen). Syngas can be burnt to produce electricity or processed to produce fuels such as diesel oil.[21]

- *Integrated Coal Gasification Combined Cycle* (IGCC) is the technology behind some experimental ‘zero emission’ projects. It is considered the most suitable technology for possible carbon capture and storage but less reliable than other options.[22] In IGCC a gas turbine burns syngas to produce electricity. Exhaust heat from the turbine is used to produce steam to power a steam turbine.[23]
- *Integrated Gasification Fuel Cells (IGFC)* - a ‘zero emission’ technology under development that does away with the steam cycle. It uses hydrogen from coal gasification in a solid fuel cell to produce electricity.[24]

4) Carbon capture and storage

There are currently no commercially available technologies to capture and store carbon. Such technology is very expensive and is unlikely to be available for at least 20-30 years.[25]

"Clean Coal" Technology in New Zealand

CCT is not widely used in New Zealand. Huntly power station only uses basic electrostatic precipitators to remove particulates but no other CCTs. There are no technologies installed at Huntly to remove SO_2, NO_X and toxic trace elements such as mercury. There are also no available technologies to limit CO_2 emissions – the main greenhouse gas.[22]

Despite the coal industry singing the praises of CCT in its promotion of coal, very little CCT would be used in proposed New Zealand coal power stations. Solid Energy only plans to use Flue Gas Desulphurisation to remove SO_2 at its planned power station in Buller but other "clean coal" technologies are not considered economically viable on a plant this size (150-250 MW).[23] Similarly at Mighty River Power's proposed coal-fired power station at Marsden B, only basic electrostatic precipitators and Flue Gas Desulphurisation are proposed[24].

Risks and failures of the technology

Coal Washing

Coal washing results in the formation of large quantities of slurry. This is placed in waste piles. Rain drains through the piles, picking up pollutants which end up in rivers and streams. This runoff is acidic and contains heavy metals.[25] In October 2000, a dam at an impoundment in Kentucky burst, releasing 250 million gallons of slurry into rivers and streams in Kentucky and West Virginia. More than 75 miles of the river was choked by the slurry, which killed all fish and river life. The spill affected the drinking water of 4,500 people.[26] Runoff from the waste piles also increases total dissolved solids (TDS) in waterways which lowers water quality.

Mercury removal

According to a report by the United Nations Environment Programme (UNEP) mercury and its compounds are highly toxic and pose a 'global environmental threat to humans and wildlife.'[27] The report also states that coal-fired power and heat production is the largest single source of atmospheric mercury emissions.[28] According to the Coal Utilization Research Council 'there are no commercial technologies available for mercury capture at coal-fuelled power plants'.[29] Furthermore, a US Department of Energy commissioned report, states that the consistent, long-term performance of mercury control has yet to be demonstrated.[30] Experimental removal of mercury is prohibitively expensive at \$761,000/kg mercury removed and even then 10% of the mercury still remains.[31]

"Clean Coal" Technology Doesn't Work

- *Case Study: American Electric Power's Gavin plant*

"Clean coal" technologies don't always work. For example, in 2001, American Electric Power's (AEP) Gavin plant in Cheshire, Ohio released sulphuric acid into the air. The release occurred due to an incompatibility between the plant's \$195 million Selective Catalytic System (SCR) to remove NO_X and a \$680 million 'wet scrubber' Flue Gas Desulphurisation system to remove SO_2[32]. Local residents complained of asthma attacks, burning eyes, headaches, sore throats and white coloured burns on their lips and tongues.[33]

To try and fix the problem, AEP shut down the SCR system at one of its units during 2002 and spent \$7 million in an attempt to reduce sulphuric acid emissions from its second unit. To allay residents' fears about pollution, the company bought the entire town for \$20 million and moved everybody out, on the condition that none of the residents sue for any subsequent health effects![34]

In 2003, despite all the money spent on 'clean coal' technologies, the plant released an estimated 680,000kg of sulphuric acid into the air.[35]

The same Flue Gas Desulphurisation technology that was used in AEP's problematic plant is to be used in New Zealand's proposed Buller and Marsden B coal-fired power stations.

A Risky Business
Despite $5.2 billion of investment in the US alone[36], clean coal research has been plagued with difficulties. For example, of the 13 clean coal projects that the US General Accounting Office looked at, eight had serious delays or financial problems – six were behind schedule by 2-7 years and two were bankrupt and will not be completed.[37]

The operators of the $297 million Healy Clean Coal project in the USA intend to retrofit the current clean coal plant with traditional technologies. The plant has been closed since January 2000 because safe, reliable and economical operation was not possible with the experimental technology.[38]

"Clean Coal" Still Pollutes
The industry prides itself on the efficiency of some of its pollution controls. However when you look at the actual quantities of pollutants emitted the figures are not so impressive. For example, the World Coal Institute uses the Lethabo Power Station in South Africa as an example of a successful emissions control programme. The plant's ESPs remove 99.8% of the fly ash. Nevertheless the plant still emits around 60,000 tons of particulates into the atmosphere every year.

Futuregen – what kind of future?
The industry rhetoric sounds very enticing – working towards a zero-emission coal-fired future. The $1 billion dollar Futuregen project in the USA is based on experimental IGCC technology. Intended to create the world's first 'zero-emissions' fossil fuel plant, the project will take 10 years to complete. It will be even longer before the technology is commercially available.[39]

In reality however, there can be no such thing as a zero-emission plant. After being collected by pollution control devices to prevent emissions to the air, pollutants are merely shifted to another waste stream as solid or liquid wastes.[40] Either that, or waste products, which are contaminated with heavy metals, are sold on for construction use. This results in these dangerous contaminants being released into the environment.

Summary

"Clean coal" is an attempt by the coal industry to try and make itself relevant in the age of renewables. Existing CCTs do nothing to mitigate the environmental effects of coal mining or the devastating effects of global warming. Coal is the dirtiest fuel there is and belongs in the past. Clean, inexpensive renewable energy options already exist. This is where investment should be directed, rather than squandering valuable resources on a dirty dinosaur.

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