

CCS REGULATION

NEWSLETTER

Welcome to the CCS Regulation newsletter. This is produced by the **MIT Carbon Capture and Sequestration Technologies Program**. It is a quarterly report designed to keep the reader up to date with the current regulatory news and issues surrounding Carbon Capture and Storage (CCS).

For more information about the program please see <http://sequestration.mit.edu>

Feature Article

Interview with Howard Herzog on the EPA Regulations for new build coal-fired power plants.

Overview

On September 20, 2013, the US EPA issued “Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources: Electric Utility Generating Units.” These performance standards set limits on the amount of CO₂ that can be emitted per megawatt-hour (MWh) of electricity generation from new coal-fired and gas-fired power plants built in the US. The MIT Carbon Sequestration Technologies Program is assessing how the EPA characterized CO₂ Capture and Storage (CCS) in their proposed rule. Howard Herzog answered a few questions on this research and his view on the performance standards.

What are these Standards for Performance?

The proposed performance standards set limits on the amount of CO₂ that can be emitted per MWh of electricity generated from new coal-fired and gas-fired power plants. The new regulations governing existing power plants will be proposed by June 1, 2014 and both rules (for existing and new builds) are to be finalized by June 1, 2015.

What are these limits?

The proposed regulation would require CCS for new coal-



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fired power plants in order to achieve a standard of 1100 lb CO₂/MWh, requiring about 40% capture of CO₂ from a conventional supercritical coal-fired power plant. The standard for new natural gas-fired power plants of 1000 lb CO₂/MWh can be reached with standard high efficiency natural gas systems and do not require CCS.

How have these limits been established?

These limits were based on determinations of “best system of emission reduction (BSER) adequately demonstrated.” Considerations for BSER include: feasibility, cost, amount of emission reductions and future technology development. Central to the EPA analysis was determining whether CCS qualified as BSER. The determinations were made separately for coal-fired generation and gas-fired generation.

Do you think that CCS has been adequately demonstrated?

This depends on how you define “adequately demonstrated.” I think it is there, or at least very close from a pure technical feasibility perspective. However, from an economic perspective, it has a way to go.

What do you think about the examples which the EPA uses to support that CCS has been adequately demonstrated on coal-fired power plants?

The EPA regulation lists four installations that they say demonstrate the feasibility of CCS on coal power systems: Kemper County IGCC plant in Mississippi; Boundary Dam Pulverized Coal (PC) plant in Saskatchewan, Canada; TCEP IGCC in Texas and the HECA IGCC in California. Three of the examples cited by the EPA are IGCC power plants. These IGCC plants with CCS are being developed in unique circumstances and caution should be used when generalizing and comparing their application of CCS to that of all coal plants.

Do you agree with the EPA that “there is insufficient information to make a determination regarding the technical feasibility of implementing CCS” on NGCC systems?

No, there have been successful implementations of CCS on gas turbines in a power plant in Bellingham, MA, USA and in the ongoing pilot tests at Mongstad in Norway.

The EPA states that they do not have sufficient information about transferring information on coal-based capture to natural gas capture. Do you agree?

Actually it is the other way round. The CO₂ scrubbing solvents used today for CO₂ capture were originally transferred from gas-fired units to coal-fired units, not the other way around as the EPA implies.

The CO₂ concentration in the flue gas stream of a coal combustion unit is 4 times higher than that in a natural gas flue. Doesn't this pose problems to carbon capture in gas power plants?

In general the lower the concentration of CO₂, the more costly it will be to remove. However there are other characteristics of the flue gas which are important: the concentration of oxygen can degrade the solvent and lead to corrosion, sulfur oxides can poison the solvent and particulates can cause foaming of the solvent. In comparing the flue gas of gas and coal units, gas-fired power plants have lower CO₂ concentrations and higher O₂ concentrations but essentially no SO_x and particulates. So, while there are some areas where capture from gas-fired exhaust gas is more challenging than coal-fired exhaust gas, there are other ways in which it is easier.

Are there any issues with scale-up of gas-fired power plants?

Demonstrations on both coal- and gas-fired power plants confirm that there are no major technical barriers that would make scaling up of gas-fired power plant CCS turbine systems less feasible than coal. Both coal and gas systems deal with unique technological barriers that have been addressed by technology manufacturers through years of pilot and demonstration projects.

Do you agree with the analysis of the cost of CCS?

The EPA has quoted the cost of implementing CCS as the additional cost to produce electricity. While this is an important estimate for the rate-payers, it does not address the mitigation cost expressed as dollars per ton of CO₂ avoided. The mitigation cost is an important amount because it enables cost comparison with other mitigation options, as well as the social cost of carbon.

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How does the mitigation cost compare to the social cost of carbon?

Using the EPA's number for the social cost of carbon of about \$33 per metric ton of CO₂, the mitigation cost from a coal-fired power plant is about double that number. For a gas-fired power plant, it is over 2.5 times the social cost of carbon.

The EPA claims that these regulations will further CCS R&D, do you agree?

No. In the analysis, the EPA says they do not expect any new coal plants to be built. As the Congressional Research Service stated: "if the standards won't have any cost or impact, because no new coal-fired capacity subject to them

will be built, then they will do little to stimulate the development of CCS technology."

What have you concluded about the EPA performance standards?

We conclude that the asymmetric treatment of coal and gas, saying that CCS is the BSER for coal-fired power plants but not gas-fired power plants, is not justified by EPA's analysis.

Thank you to Howard Herzog for this interview.

State CCS Regulation News and Updates

US States and Canada Provinces

October 30, 2013. California, Washington, Oregon and the Province of British Columbia, Canada, have signed the Pacific Coast Action Plan on Climate and Energy. These states have agreed to strategically align their climate and clean energy policies. They have pledged to work together to account for the costs of carbon and back efforts to limit GHG emissions from power plants.

The Action Plan outlines measures to account for carbon emissions costs in each of the four jurisdictions. California and British Columbia already have carbon-pricing programs. Oregon will expand its existing programs to set a price on carbon and Washington will set emissions limits with market mechanisms to meet these limits. This agreement also supports strong federal policy on power plant emissions and emphasizes the importance of state flexibility in designing emissions reduction programs.

<http://www.energysolutionsforum.com/states-sign-climate-pact-canadian-province/>

California

November 15, 2013. California's Division of Oil, Gas and Geothermal Resources (DOGGR) has issued two key

documents related to fracking and other well-stimulation treatments. These documents are regulations to implement the recently enacted Senate Bill 4 (SB 4). These draft regulations cover: (i) the establishment of a well-stimulation treatments under the California Environmental Quality Act (CEQA), and (ii) a notice of preparation (NOP) that initiates review of well-stimulation treatments under the California Environmental Quality Act (CEQA).

These regulations exclude CO₂ injection for the purpose of EOR from the definition of well-stimulation treatment. As a result these regulations do not apply to carbon sequestration achieved through such injection.

<http://www.lexology.com/library/detail.aspx?g=bbfef719-0f8a-4c97-a564-9d2eec7ed941>

California

December 23, 2013. California Energy Commission and Hydrogen Energy California LLC (HECA) worked with various relevant federal, state and local agencies in connection with the needed approvals for the HECA coal gasification power project in Kern County. They are still facing disagreements over air quality calculations and other issues.

<http://www.energybiz.com/article/12/12/hydrogen-energy-california-advances-coal-gasification-project>

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Federal CCS Regulation News and Updates

October 29, 2013. The US Treasury Department has halted funds to support the development of coal-fired power plants around the world. They are making an exception for projects: (i) where CCS technology is employed or (ii) cited in certain least-developed countries using high-efficiency coal combustion technologies.

http://www.nytimes.com/2013/10/30/us/us-says-it-wont-back-new-international-coal-fired-power-plants.html?_r=0

November 1, 2013. President Obama has created a Interagency Climate Change Adaption Task Force on climate preparedness and resilience to and how the Federal Government can best respond to the needs of communities nationwide that are dealing with the impacts of climate change.

<http://www.elp.com/articles/2013/11/president-obama-creates-white-house-task-force-on-climate-change.html>

November 13, 2013. The Congressional Budget Office has estimated that a carbon tax of \$25-per-ton, that would rise 2% each year, could help cut the deficit by \$1 trillion over the next decade.

<http://thehill.com/blogs/e2-wire/e2-wire/190167-cbo-carbon-tax-chops-1-trillion-from-deficit>

December 17, 2013. The EPA has finalized its rule that excludes as a hazardous waste CO₂ streams that are associated with geological sequestration. This rule applies to the CO₂ streams, which are injected into Underground Injection Control (UIC) Class VI wells.

<http://www.epa.gov/wastes/nonhaz/industrial/geo-sequester/prepub-co2-sequestration.pdf>

December 18, 2013. Sen. Max Baucus (D-MT) has released a discussion draft of legislation that aims to overhaul US energy tax incentives. The new proposal includes a technology-neutral tax credit for the production of clean electricity. The amount of credit available would be in direct proportion to the ratio of electricity production to GHG emissions. The incentive would be available either as a production tax credit of up to 2.3 cents per KWH or an

investment tax credit of up to 20% of the cost of the investment. Generally, it would be available only for facilities that begin operation on or after January 1, 2017. However, after 2016, credit could be claimed for existing facilities that undertake a CCS retrofit that captures at least 50% of CO₂ emissions.

<http://biomassmagazine.com/articles/9832/sen-baucus-releases-proposal-to-overhaul-energy-tax-incentives>

January 2, 2014. The EPA has published final regulations that intend to remove potential obstacles for the implication of CCS and allow new coal-fired power plants to operate. The rule creates a consistent national framework to facilitate the technology, including language that exempts the carbon streams pumped underground from the EPA's hazardous waste regulations under Resource Conservation and Recovery Act (RCRA). The EPA expects that this 58-page document will reduce uncertainty associated with identifying CO₂ streams under RCRA subtitle C; and will also facilitate the deployment of geologic sequestration by providing additional regulatory certainty. The agency also issued a draft guidance explaining the process for transitioning wells used to inject CO₂ for oil and gas development into wells used for CCS.

<http://thehill.com/blogs/regwatch/energy-environment/194276-epa-publishes-carbon-capture-regs>

January 10, 2013. Energy and Power Subcommittee Chairman Ed Whitfield (R-KY) and Senator Joe Manchin (D-WV) have introduced *The Electricity, Security and Affordability Act*. This Act is a response to the EPA's regulations for new and existing fossil-fired power plants. The Act aims to repeal the EPA's proposed rules to establish GHG standards. It establishes separate standards for coal and gas. The standards for coal-fired plants are to be established after a 1-year averaging period and existing coal plants are not to be affected by the rule until an agreed date.

<http://energycommerce.house.gov/fact-sheet/whitfield-manchin-discussion-draft-plan-keep-american-electricity-affordable-and-reliable>

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International Regulatory News

Japan

November 3, 2013. Japan has announced that it will not be able to meet the pledged 6% reduction of GHG emissions, rather it anticipates a rise of 3% by 2020. The rise in GHG emissions is primarily due to the Fukushima disaster and its impact on nuclear energy use in Japan.

http://www.nytimes.com/2013/11/16/world/asia/japan-shelves-plan-to-slash-emissions-citing-fukushima.html?_r=0

UK and South Korea

November 7, 2013. The UK and South Korea have agreed to collaborate on climate change. In a joint report they stated that any future role for coal would be dependent on the successful deployment of CCS.

<http://www.rtcc.org/2013/11/07/uk-and-south-korea-agree-to-collaborate-on-tackling-climate-change/>

US and Norway

November 8, 2013. The US and Norway have announced their commitment to support the Global CCS Test Center Network. The Network was first launched by the CO₂ Technology Centre Mongstad (Norway), NCCC (US) and other carbon capture test facilities.

<http://www.hydrocarbonprocessing.com/Article/3276988/US-Norway-seek-to-improve-CO2-capture.html>

EU

November 14, 2013. The sales of the second round of the NER300 Programme have successfully started. The European

Investment Bank gradually phased in 1.65 million EU Allowances over the first 3 days.

<http://www.eib.org/about/press/2013/2013-185-european-investment-bank-confirms-start-of-sales-under-second-round-of-ner-300-initiative.htm>

UK

November 20, 2013. The UK has announced that like the US, it will no longer fund the development of coal-fired power plants overseas. The UK has provided about \$500m (£300m) for such projects in the past seven years, mostly through its funding for development banks. Several other European countries have pledged to provide no more aid to building new coal plants. However, Germany and Japan, two of the biggest funders of coal development at \$6 billion and \$9 billion respectively, have not made the same commitment.

<http://www.theguardian.com/environment/2013/nov/20/uk-coal-fired-power-stations>

UN Climate talks

November 24, 2013. UN Climate talks in Warsaw, Poland, only delivered modest results. The two-week session was supposed to establish a framework of how to curb GHG emissions through 2020, however it only produced a vague road map on how to prepare for a global climate pact that is supposed to be adopted in two years. CCS was in the spotlight as both the UN Secretary General, Ban Ki-moon and the UN's Climate Change Secretariat, Christina Figueres made several demands for coal and other fossil fuel industries to adopt CCS to reduce CO₂ emissions.

<http://insideclimatenews.org/news/20131122/global-boom-coal-plants-begs-carbon-capture-solution>

Malaysia

November 25, 2013. The legislative assembly of the Malaysian state of Sabah has approved an amendment to its Forestry Enactment which paves the way for the Sabah Government to begin carbon trading.

<http://www.eco-business.com/news/sabah-be-first-malaysian-state-deal-carbon-trading/>

China

November 28, 2013. China has launched two new pilot carbon trading schemes in Beijing and Shanghai. The scheme forces companies to buy credits to cover any CO₂ emissions above their allotted quota, as China aims to cut the 2005 rate of CO₂ emissions per unit of GDP growth by 40-50% by 2020.

<http://www.reuters.com/article/2013/11/25/us-china-carbon-idUSBRE9A007E20131125>

France

December 19, 2013. France's Parliament has agreed the 2014 budget which introduces a carbon tax on the use of gas, heating oil and coal. The tax of EUR7 (\$9.50)/mt of carbon, started on January 1, 2014. In 2015, the tax will increase to EUR 14.5 (\$20)/mt and will be applied to transport fuels such as gasoline and diesel.

<http://www.platts.com/latest-news/electric-power/london/france-adopts-2014-budget-carbon-tax-on-fossil-26563408>

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CCS Project News

October 1, 2013. Aquistore, the \$22 million carbon storage research project operated by PTRC and funded largely by SaskPower, has been overspent by \$5.9 million.

<http://www.cbc.ca/news/canada/saskatchewan/saskpower-failed-to-monitor-overspending-in-aquistore-project-1.1874571>

October 4, 2013. Babcock & Wilcox's Power Generation Group have signed a \$49 million agreement with FutureGen Alliance to perform the second phase of its front-end engineering and design work for FutureGen 2.0.

<http://www.babcock.com/news-room/Pages/BW-Begins-Front-End-Engineering-and-Design-Work-for-FutureGen-2-Carbon-Capture-Project.aspx>

October 9, 2013. The ADM facility that will pump CO₂ underground at the Decatur CCS project in Illinois is nearing completion. The \$208 million carbon sequestration project could begin CO₂ injection in the summer of 2014.

http://herald-review.com/news/local/adm-facility-to-pump-co-underground-nears-completion/article_abac5726-3097-11e3-bc0d-001a4bcf887a.html

October 18, 2013. SaskPower's CCS project at Boundary Dam is 90% complete and still on track to enter the testing and commissioning phase by April 1, 2014. However, the \$1.3 billion project is now \$115 million over budget due to unforeseen events, which include: an asbestos scare, unanticipated engineering work and a shortage of labor.

<http://www.timescolonist.com/saskpower-says-boundary-dam-carbon-capture-project-115-million-over-budget-1.664795>

October 29, 2013. Mississippi Power has revised the start date of its Kemper County CCS project. This project is now expected to come online in the fourth quarter of 2014. The company also further revised its cost for the facility and as a result, Southern Company and Mississippi Power will record a pre-tax charge to income for this estimated probable loss of \$150 million (\$93 million after tax).

http://www.mississippipower.com/kemper/news_oct29-2013.asp

October 31, 2013. The DOE recommended moving forward with FutureGen 2.0 after the final Environmental Impact Statement (EIS) found that the CCS project would have minimal environmental impacts.

<http://www.bna.com/energy-department-review-n17179879759/>

November 11, 2013. Abu Dhabi National Oil Company (ADNOC) and Masdar have signed a joint venture to develop the first CCS project in the region. The project will capture CO₂ at the Emirates Steel facility and be piped 50km to fields, owned by ADNOC, for EOR. The project is set to be completed by 2016 and will sequester up to 0.8 Mt CO₂/yr.

http://gulfbusiness.com/2013/11/adnoc-masdar-jv-launch-first-carbon-capture-project/#.Us7Q5nl_ePc

November 21, 2013. Hitachi has begun construction at the SaskPower's Shand power station in Saskatchewan. The 120 tons CO₂/day project is due to be completed and operational by the end of 2014.

<http://www.hitachi.com/New/cnews/131121a.html>

December 10, 2013. Alstom, Drax and BOC have been awarded a Carbon Capture FEED contract for their coal-fired White Rose CCS project in the UK. The FEED contract also includes the planned development of the CO₂ pipeline: Yorkshire Humber CCS Trunkline.

<https://www.gov.uk/government/news/drax>

December 12, 2013. The DOE has made \$8 billion available in loan guarantees to support innovative advanced fossil energy projects that avoid, reduce or sequester GHG.

<http://energy.gov/articles/department-energy-releases-8-billion-solicitation-advanced-fossil-energy-projects>

December 30, 2013. The DOE announced that it would cost-share the \$435.6 million Lake Charles CCS project, Louisiana. The DOE will provide \$261.4 million for the capture and transport of CO₂. This money is in addition to the previously awarded \$13.9 million for preliminary design and related activities.

<http://www.pennenergy.com/articles/pe/2014/01/doe-issues-final-approval-for-lake-charles-ccs-project-funding.html>

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Publications and Releases

IPCC: Summary for Policymakers

September 27, 2013. The IPCC released the *Summary for Policymakers* portion of the first volume of the IPCC's Fifth Assessment Report (AR5), part of the Working Group I report on "The Physical Science Basis." The report covers a comprehensive assessment of the physical aspects of climate change and focuses on elements that are relevant to understanding past climate change, as well as to document current and predict future climate change.

http://www.ipcc.ch/news_and_events/docs/ar5/press_release_ar5_wgi_en.pdf

Congressional Research Service: Technology Assessment

October 24, 2013. The Congressional Research Service released a report entitled: "*Carbon Capture: A Technology Assessment*." The 100 page report focuses on the capture portion of the CCS technology. The report assesses prospects for improved, lower-cost technologies for post-combustion, pre-combustion and oxy-combustion capture. The report indicates all 3 technologies have been successful with a capture rate above 90%, but the drawback remains the expensive price tag.

<http://www.lexology.com/library/detail.aspx?g=77860bd3-e142-4ee4-be38-a4c462fe0293>

IEA: Energy Outlook 2013

November 12, 2013. The IEA has released its *World Energy Outlook 2013*. It states that the global energy demand will increase by one third by 2035. They state

that the future global demand for coal is uncertain because regional environmental policies vary in stringency. However, coal will continue to dominate the power sector along with other fossil fuels through 2035.

<http://www.worldenergyoutlook.org/publications/weo-2013/>

MIT: 2013 Energy and Climate Outlook

November 20, 2013. MIT researchers have published The "*2013 Energy and Climate Outlook*" which suggests that current efforts are not enough to prevent climate consequences.

<http://web.mit.edu/newsoffice/2013/study-current-efforts-not-enough-to-prevent-climate-consequences.html>

Energy Institute's CCS committee: Hazard Analysis

November 25, 2013. The Energy Institute's CCS committee has published its Hazard Analysis for offshore carbon capture platforms and offshore pipelines. The research report has been developed and is partly funded by the GCCSI, Air Products, Progressive Energy and AMEC. The report acts as a guide for the health and safety hazard analysis for the offshore management of pipelines and platforms, where CO₂ will be present as a part of CCS installations. It communicates existing knowledge on pipeline and offshore facility design and operations and identifies areas of uncertainty where existing knowledge cannot be applied with sufficient confidence.

<http://www.environmental-expert.com/news/energy-institute-publishes-ccs-offshore-hazards-mitigation-research-402863>

Images: Cover photo: <http://photographyhd.net/frozen-air-bubbles-in-abraham-lake/>

Page 1: Frozen power lines: NOAA

This newsletter was constructed using information from internet searches. The websites used have been cited.

Holly Javedan compiled this report. For more information, questions and comments please email javedan@mit.edu. Thank you.