Testimony of Robert Hilton
Before the U.S. House of Representatives
Subcommittee on Environment and Subcommittee on Energy
Of the Committee on
Science, Space, and Technology
Hearing on **Science of Capture and Storage: Understanding EPA's Carbon Rules**

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Introduction

Good morning. My name is Robert Hilton. I hold the position of Vice President, Power Technologies for Government Affairs for Alstom. I would like to thank Chairman Schweikert and Chairwoman Lummis and Ranking Members Bonamici and Swalwell as well as the entire Subcommittees for this opportunity to address these key issues on Carbon Capture.

Alstom is a global leader in the world of power generation, transmission, and transportation infrastructure. We set the benchmark for innovative and environmentally friendly technologies. More than 50% of the power plants in the United States have Alstom equipment, 40% of the electricity in the US is dispatched over Alstom software, and 25% of the world's electricity is generated on Alstom equipment. Alstom has the world's largest service business devoted to the maintenance of power generation equipment and is the world's largest air quality control company.

Alstom employs more than 93,000 people in 100 countries, and had sales of $27 billion in 2012-2013. In the U.S., Alstom employs approximately 7,000 full time permanent employees in 45 states. That number virtually doubles when you include workers hired for specific projects.

Alstom has a broad portfolio of power generation technology options: including coal, oil, natural gas, wind (both on shore and off shore), and hydro, biomass, geothermal, solar and nuclear. Significant pillars of our program are rapid and successful deployment of non-$C0_2$ sources of generation, namely nuclear and renewables; reduced $C0_2$ emissions through more efficient generation; and the capture of $C0_2$ from fossil fuel powered generation (Carbon Capture and Storage (CCS)). Alstom invests approximately $1 billion annually in research and development with significant activities in the US.

Alstom is a leader in the field of Carbon Capture having completed work on four pilot or validation scale plants and with 10 pilots, validation, and commercial scale demonstration plants in operation, design, or construction worldwide.
These projects include both coal and gas generation facilities. Alstom is commercializing three first generation capture related technologies: chilled ammonia post combustion capture, advanced amine post combustion capture, and oxy-firing combustion technology. We also have second generation technologies in development like chemical looping (in cooperation with Department of Energy (DOE)) and regenerative calcium cycle.

Status of Carbon Capture Technology

My testimony today will address the status of the Carbon Capture portion of CCS as a full scale commercial technology.

Carbon Capture is, within the realm of innovation, no different than any other technology under development. It is required to move through progressive stages of development at consistently larger scale or size. This process has been shown over decades to be the best approach to ensure commercial success by meeting the high

standards of our industry and providing the confidence and reliability required by the power industry and electricity consumers.

Alstom has taken each of its Carbon Capture related technologies from the bench level to small and then larger pilots, followed by validation scale demonstrations with the aim to finally reach commercial scale demonstration. To date, no Carbon Capture technologies have been deployed at commercial scale. Alstom has successfully taken several of its technologies through the validation scale demonstration. This stage is the proof of technology in real field conditions (or in this case actual power plant flue gas). It is at this point we can say confidently that the basic technology works.

However, the final stage to reach commercial status is to perform a demonstration at full commercial scale. There are several reasons for this requirement. It is critical to be at commercial scale to define the risk of offering the technology. This cannot be defined until the technology can be shown to work at full scale. This is the first opportunity that we have to work with the exact equipment in the exact operating conditions that will become the subject of contractual conditions when the technology is declared commercial and is offered under standard commercial terms including performance and other contractual guarantees. This also becomes the first opportunity to optimize the process and equipment to effect best performance and, very importantly, seek cost reduction. These too are required to define commercial contractual conditions. Finally, our customers would be reluctant to invest in Carbon Capture technologies that have not been demonstrated to full commercial scale.

Based on these criteria, Alstom does not currently deem its technologies for Carbon Capture commercial and, to my knowledge, there are no other technology suppliers globally that can meet this criteria or are willing to make a normal commercial

contract for CCS at commercial scale. I emphasize however that the technologies being developed by Alstom and others work successfully.

Clean Air Act Definitions

The Clean Air Act defines four criteria for the application of BSER or Best System of Emission reduction – to coal or anything else. The criteria are supported in the draft Environmental Protection Agency (EPA) New Source Performance Standards (NSPS) for carbon dioxide (CO2) emissions by project examples. My testimony reviews these examples as follows:

Feasibility- is the technology technically feasible?

Looking at the projects cited by EPA at the time of this writing: Kemper is under construction and not demonstrated (reference: Brian Toth presentation at the Coal Technology Symposium' held on March 5, 2014, in Washington D.C.); Sask is under construction and not demonstrated and has delayed start-up until July 2014 (reference: the Honorable Brad Wall, Premier of Saskatchewan at same symposium); TCEP/ Summit is not financed and hasn't started construction (reference: Sasha Meckler of Summit at the same symposium); HECA is not financed and has yet to start construction; NRG Parrish is has yet to start construction; AEP Mountaineer was only 2.3% of the plant gas stream and therefore should not qualify as significant as referenced in the rule making; Basin Electric/ Dakota Gasification is a producer of natural gas and a fertilizer plant - not a power plant. Four of the six projects are gasifiers and high pressure technology not suited to pulverized coal or NGCC (natural gas combined cycle) electricity producing plants (which are at atmospheric pressure). Alstom suggests this summary demonstrates the EPA referenced projects fail to meet the "technically feasible" criteria. These technologies are not operating at significant scale at

any site as of the rule publication. We do not support mandating technology based on proposed projects (many of which may never be built). These facts lead to the conclusion that the technology is not “adequately demonstrated” to be feasible at full scale.

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Cost - are costs reasonable?

Alstom cannot comment in detail about the status of projects proposed by other companies. But based on facts in the public domain I’m aware of no CCS projects that would be considered cost competitive in today’s energy economy. The five carbon capture and sequestration projects cited in the NSPS proposal as examples for having met the cost criteria in the NSPS rule all either rely on EOR or by-product revenue, federal subsidy, or they will not economically dispatch. We would suggest that in setting economic criteria for technology, EPA consider the” typical commercial power plant which will not have federal subsidies and will likely not have access to chemical or EOR revenue. EPA needs to recognize that both chemicals and EOR are niche opportunities and not available to most power plants. In the case of EOR, it works only in proximity to oil fields that can be tapped with tertiary flooding and where pipelines exist to reach those fields; all are unique circumstances not available to the typical commercial power plant in the US.

Size of CO2 emission reductions:

EPA, in the rule, states that this rule will not achieve significant reductions in CO2 emissions.

Technology- will the system promote further development

As detailed below, this regulation will essentially stop the development of CCS. Without new coal plants, it is unlikely technology developers will continue to invest in CCS development. Since the proposed regulation provides a significantly lower cost alternative (NGCC without controls) to the

application of CCS to coal, there is unlikely to be a market for at least 10 years, and most R&D cannot be sustained for that period. Industry bases R&D on market potential and return on investment. With no market in sight, investment will stop. One only need to look at slowing pace of private and public investment world-wide in CCS projects as shown in the annual survey of the Global Carbon Capture and Storage Institute (GCCSI), which results from economic conditions and lack of progress on climate change negotiations as proof that EPA's assumption are unrealistic.

We differ with EPA on the notion that these NSPS regulations will spur development of new technology (as required by Congress in the Clean Air Act).

Let us examine the history of the Clean Air Act (CAA). When the CAA was enacted, the first pollutant was particulate matter. Industry had been developing collectors and precipitators since the 1920's, so was well prepared. When EPA called for sulfur dioxide (Sox) control, the industry had built its first full-scale scrubbers in 1942 and was well prepared. I personally worked on my first full scale scrubber in 1970. When the nitrogen oxides (NOX) State Implementation Plan (SIP) call came in 1999, the industry had been deploying reduction technologies since the early 1980s. When mercury regulation came in 2010, the industry had been deploying mercury systems since the mid-1980s. And in the case of Mercury and Air Toxic Standards (MATS) the industry demonstrated that the originally proposed standards could not be met and worked with EPA to develop EPA's revised MATS standards.

NSPS is different. The issue we are now faced with is the industry did not in earnest begin work on capture of CO2 from atmospheric gases until 2000-2002. The technology is not fully developed and the regulation proposed is ahead of technology development. It should also be noted that carbon capture is much larger, complex

and technically sophisticated compared with any of these previous technologies. From this history, we see that the CAA has been a **market driver** and **not a technology driver**. Industry has always moved to be prepared for the next environmental issue.

Clean Coal Power Initiative (CCPI) Projects

In the Energy Policy Act of 2005, Congress expressly prohibited EPA from basing any regulation on projects receiving CCPI money. EPA has defended its use of these projects to name partial capture on the word "solely." All of the current or proposed plants I'm aware of have received CCPI money except Basin Electric (not a power plant) and Sask (a Canadian project with equivalent Canadian funding). Similarly, none of the projects referenced in the regulation are designed for partial capture except Kemper.

Impacts on Electricity Consumers

The proposed regulations would force generators to move from coal to natural gas, which potentially could have major impact on electricity consumers.

Coal with CCS under current market conditions would not compete with natural gas without CCS due the extreme capital cost of the CCS equipment and additional operating cost as currently viewed by both generators and developers and even in DOE National Energy Technology Laboratory (NETL) studies. Thus, anyone building new generation would logically build Natural Gas Combined Cycle (NGCC) plants. However, let us look at the impact this regulation will have.

With no new coal power generation being built it's our view that this presents a real threat to the US economy both in terms of employment in the industries that build and supply materials for coal plants, as well as coal mining, transportation and

maintaining the necessary skill sets to design, build and operate such plants through a period of 10 or more years of inactivity.

Coal has always been the fuel that balanced electric prices through price spikes of gas and other market conditions. It should be noted that while natural gas is currently low in price and abundant (and projected by EIA to remain so), dependence on gas this winter has driven consumers price spikes with electricity reaching $7000 per MWh due to infrastructure constraints on gas fuel supplies. This figure is sharply different than EPA's expected $70 per MWHr.

Similarly, reliance on EIA forecasts that no coal plants will be built in any event is precarious. EIA forecasts are a snapshot based on a set of assumptions and have consistently failed to see market fluctuations and interruptions. They are in fact revised annually and sometimes more frequently. We point to the EIA assumption of gas at $4.50 per mmBtu through the decade and prices have already risen in recent months to $5.50- 6.50 per mmBtu and sometimes higher.

Alstom is a leading global developer of carbon capture technology. The true state of the technology (setting aside 1-5MW pilots) is that today there has been one 40 MW capture unit at AEP's Mountaineer Plant (since shut down), one 35 MW capture plant at Southern Company's Plant Barry (still in operation) on coal; there are two small pilots in early development in Mongstad, Norway on natural gas and refinery gas. This is the essentially the extent of the largest current capture technology with sustained operation on conventional power plants. DOE is participating in a number of projects cited by EPA in its text which are about or nearly demonstration size that are all estimated to start between late 2014 and 2018. Alstom would point out the recent report by the Congressional Research Service (Carbon Capture and Sequestration (CCS): A Primer, Peter Folger, Specialist in Energy and Natural

Resources Policy; May 14, 2012), which calls into question whether all or any of these will become fully operational.

Alstom's view is that while carbon capture technology has been proven to work, the industry has yet to reach demonstration stages to reduce the cost and reduce the risk of scaling these technologies from pilot or validation scale to full scale. Thus Alstom would challenge EPA on the argument that Carbon Capture is available and adequately demonstrated. In our view without full scale demonstration, the technology should not be considered for deployment across the industry or for application as NSPS or best system of emission reduction as the industry is not in a position to make proper commercial warranties and guarantees as required...

Technology Scale-Up and Integration

EPA indicates it has done literature searches and reviewed other sources of information to determine that all the components of CCS are available. However, an important point EPA misses is that the true risk in any complex multi-stage process such as CCS is the scale-up and integration of the components. The risk is defined when at scale you need to deal with integration issues such as:

- How does the capture process turn down with generation load;
- What is the potential impact on generation if the capture plant is dependent of the steam load of the generator;
- What happens to compression when load on the capture plant is reduced and does that subsequently impact transportation or injection given instantaneous load drop and increase;
- How will volumes of water and byproducts from impurities in the flue gas be handled and will they effect injection; and

- What is the risk associated with shutting down generation when the capture or subsequent processes fail?

The list goes on but the point is these all create risks which need to be understood by scaling up and performing demonstrations. This has been reflected in the current market by two of the EPA projects having to be financed internally and with the generator accepting the risks (not normal in the power industry) and in two other projects where financing by US financial institutes does not exist and the projects have had to seek financing arrangements outside the US. This truly reflects that CCS is not ready to be mandated for deployment. EPA's arguments are similar to a statement that since all car components are known, everyone can build their own car and there is no need for companies that assemble and guarantee cars.

Customer Guarantees

Alstom would also point out that it is unaware that any supplier of this technology is ready or able to offer commercial guarantees for such full-scale systems of carbon capture. All utility generators require extensive performance guarantees and warranties which cannot be offered without proper demonstration at scale. All the projects that form a basis for the EPA rule would require extensive revenue sources from niche market opportunities like EOR and chemicals and large federal subsidies. None would stand alone on a common commercial basis. This would in turn mean that no new coal burning plant could be permitted or financed. Hence it is unlikely that such systems will be available prior to the EPA obligatory eight-year review of this proposed NSPS.

CCS Technology Roadmap

Alstom would also point out that DOE has developed a comprehensive roadmap and timeline for the commercialization of CCS technologies which ultimately points to

general deployment around 2020; although the timeline for commercial deployment cannot be clearly defined until there is full scale demonstration. After the first generation technology has been demonstrated at scale, the hope is second generation technologies can reduce costs, although they will not have been demonstrated at that time. This timeline, if embraced by EPA, would set CCS aside until the EPA suggested eight-year review of NSPS, thus avoiding conflict between agency visions.

By simply requiring all technologies be the highest possible efficiency (such as Ultra Super Critical technology), this proposal would promote the policy of having the best available technologies to replace the older less efficient existing fleet. It also would be a good transition for the existing fleet. Alstom has estimated that using best efficient technology and then upgrading the existing fleet, the industry can combine to exceed proposed targets for reduction in CO2 prior to 2020 and the next NSPS review.

Alstom would also take one further exception to the position that this rule would incent the development of CCS. Our view of the market and industry is that public utility commissions and regulators are struggling to maintain the lowest cost of electricity to ratepayers. Consequently, in today's market of moderate natural gas prices, , it is very unlikely that any commission will allow the recovery of development costs on existing plants based on a new plant rule that allows uncontrolled natural gas alternatives that are obviously less expensive. Without the ability to find cost recovery or government subsidies, it will not be possible to reach demonstration scale critical to the successful adoption and application of the CCS technology by generators and gain acceptance by the financial community that are necessary to achieve significant carbon reductions..

In conclusion, we believe the failure to meet the Clean Air Act criteria should prompt EPA to reconsider crafting carbon control regulations more in line with the technology development and DOE timeline.

Thank you for the opportunity to present this testimony...