

Arkansas Department of Environmental Quality

Clean Power Plan Heat Rate Improvement



Stakeholders' Meeting
October 1, 2014
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Heat Rate

- * Measure of Efficiency:
 - * Heat Input (Fuel Used)/Power Generated
 - * BTU/KWh
- * Lower heat rates - more efficient
- * Net vs Gross
- * Heat rates can vary over time even for the same EGU

Rule Proposal

- * The EPA's analysis finds that a total of 6% heat rate improvements:
 - * best practices that have the potential to improve heat rate by 4%
 - * equipment upgrades that have the potential to improve heat rate by 2%

Technologies to Improve Heat Rate

- * Sargent and Lundy in 2009 titled “Coal-Fired Power Plant Heat Rate Reductions.” Department of Energy’s (DOE) National Energy Technology Laboratory (NETL) study
- * National Energy Technology Laboratory (NETL), 2008. Reducing CO₂ Emissions by Improving the Efficiency of the Existing Coal-fired Power Plant Fleet, DOE/NETL-2008/1329. U.S. Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA.

Technologies to Improve Heat Rate

- * Efficiency improvements in the boiler, turbine, flue gas system, air pollution control equipment and the water treatment system:
 - * Materials Handling, Economizer, Boiler Control System, Sootblowers, Air Heaters
 - * Turbine, Feedwater Heaters, Condenser, Boiler Feed Pumps
 - * Induced Draft Fans, Variable Frequency Drives
 - * Flue Gas Desulfurization, Electrostatic Precipitator, Selective Catalytic Reduction
- * Other Studies:
 - * 8.7-15% improvement identified

Heat Rate Improvement Assessment

- * EPA assessment of fleet-wide HRI potential that can be attributed to operation and maintenance practices and equipment upgrades
- * Heat rate improvements by:
 - * operating under recommended operation and maintenance conditions (best practices), and
 - * installing and using equipment upgrades

Heat Rate Improvement Assessment

- * Developed unit-level statistics from over 60 million rows of hourly data:
 - * The EGU study population consists of 884 coal- and petroleum coke-fired EGUs that reported both heat input and electrical output to the EPA's Clean Air Markets Division in 2012

Heat Rate Improvement Assessment

- * Statistical analysis of hourly heat rates:
 - * Evaluated fluctuations
 - * Compensated for known factors
 - * Derived improvement %
- * Focused on top 10 performing units
- * Assumed reductions at top 10 could be done at other units

Heat Rate Improvement Assessment

Table 2-12. Assessment of heat rate improvement potential via best practices

% Reduction from reported heat input to p10	Study population heat rate (Btu(kWh-gross))²⁷	Reduced study population heat rate (Btu/kWh-gross)	Study population heat rate improvement (%)
10	9,753	9,623	1.3
20		9,493	2.7
30		9,363	4.0
40		9,233	5.3
50		9,103	6.7

Technical Support Document (TSD) for
 Carbon Pollution Guidelines for Existing Power Plants:
 Emission Guidelines for Greenhouse Gas Emissions from Existing
 Stationary Sources: Electric Utility Generating Units.
 GHG Abatement Measures

Heat rate improvement via equipment upgrades

- * The EPA identified 16 EGUs that reported a single year-to-year heat rate improvement of 3-8%. In two of these cases able to identify equipment upgrades responsible for 2-3% heat rate improvement:
 - * Believe that equipment upgrades were the most likely cause of some of the observed heat rate improvements
- * EPA Region 7 data for seven coal-fired units:
 - * Turbine efficiency and condenser performance upgrades, installation of variable frequency drive fans, reducing boiler air in-leakage and others.
 - * Together, these measures achieved from 0.25% to 3.5% heat rate improvement
- * EPA WEBCO Study:
 - * Equipment upgrades 2.3-4.1%
 - * Best Practices 0.5% - 2.5%?
- * Sargent and Lundy:
 - * 4% increase based on improvements considered “best practices”

Rule Proposal

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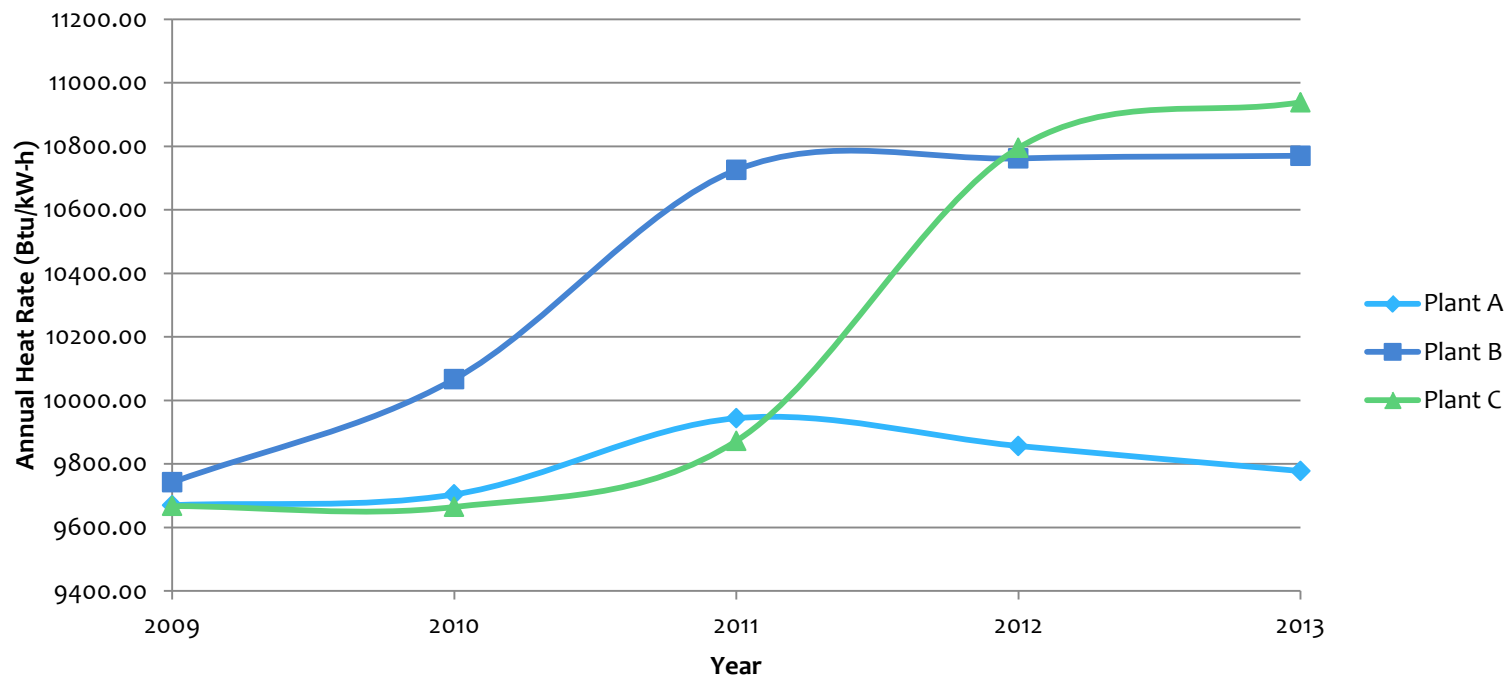
Potential Heat Rate Improvements (Facility Estimate)

- * Independence Unit 1 up to 4%
- * Independence Unit 2 up to 2%
- * White Bluff units up to 4%
- * Flint Creek - Several opportunities identified, no estimate provided
- * Turk - No opportunities for meaningful gains beyond original design identified
- * Plum Point unit (negligible)

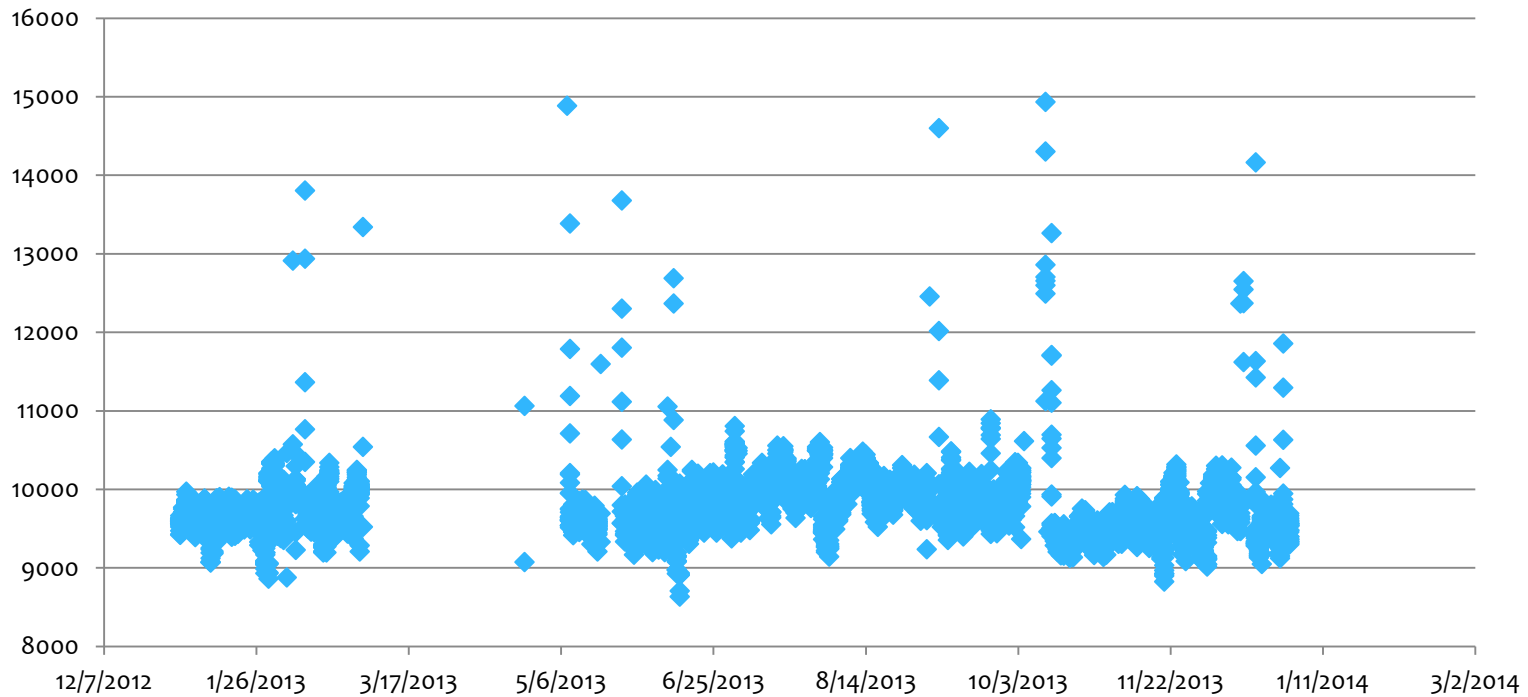
Energy Information Administration Data

	2012 Approx. Heat Rate/Rank	2013 Approx. Heat Rate/Rank
Turk	3	1
Plum Point	32	58
Independence	106	66
White Bluff	137	111
Flint Creek	129	165

5 Year Annual Heat Rates at 3 Arkansas Facilities (CAMD)



Hourly Heat Rates at Arkansas Facility (truncated)



EPA is soliciting comments on Building Block 1

- * Whether building block 1 should include potential improvements at more than just coal plants
- * Whether EPA should use 6% (as opposed to 4%) as a reasonable estimate of heat rate improvement that could be achieved at coal plants through use of best practices to reduce hourly heat rate variability
- * Whether EPA should use 4% (as opposed to 2%) as a reasonable estimate of heat rate improvement that could be achieved at coal plants through equipment upgrades
- * The quantitative impacts on the net heat rates of coal-fired steam EGUs of operation at loads less than the rated maximum unit loads

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