

Benefits Analysis of Sunflower Electric Power Project



*Power Plant Improvement
Initiative*

*Demonstration of an
Integrated Combustion
Optimization System*

George W. Pukanic, Office of Project Management
National Energy Technology Laboratory



Executive Summary

- **Demonstration projects are critical to successful commercialization of technology developed under DOE's Fossil Energy R&D program.**
- **Successful commercial application of Integrated Combustion Optimization System in United States would significantly reduce emissions.**
 - 45,670 tons per year of NO_x
- **As much as \$252 million to \$674 million could be saved by power companies installing equipment needed to achieve these low emissions.**



Outline

- **Description of Integrated Combustion Optimization System.**
- **Quantitative estimates of benefits of Sunflower Electric Power project.**
 - Benefits to Nation
 - Benefits to Sunflower Electric Power's Holcomb plant
- **Approach used to calculate benefits.**



Sunflower Electric Power Project

- A 360 MW_e demonstration of Integrated Combustion Optimization System.
- Installed on a PC Boiler with opposed-wall configuration using coal from Wyoming's Powder River Basin at Sunflower Electric Power's Holcomb Station Unit 1, Garden City, KS.



Holcomb Station

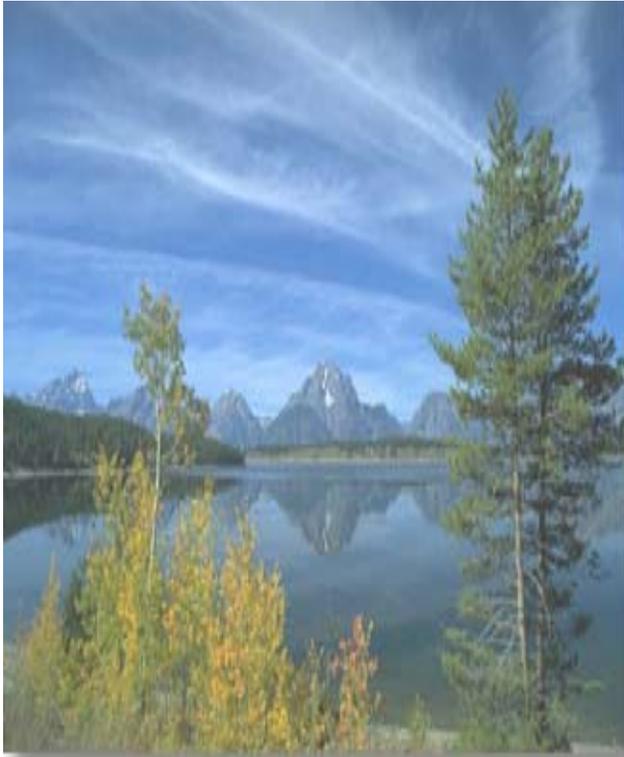


Integrated Combustion Optimization System

- Integration of modified Low-NOx burners with separated overfire air, furnace sensors, coal flow measuring and control devices, and supervisory software.
- Will reduce NOx emissions to a range of 0.15 to 0.22 lb/MMBtu and simultaneously increase power output.
- Forecast to be installed on 8.4 GW of existing coal-fired capacity.



Advantages of Integrated Combustion Optimization System



- **NOx emissions reductions of 50%**
- **Capital cost only 20% to 40% of SCR costs.**
- **Improvement in stability of boiler performance.**
- **Improvement in power output of 2% when dense pack turbine technology employed.**
- **Potential to generate ash that contains carbon for mercury control without excessive levels of carbon that could inhibit commercial sales of ash.**

Performance at Holcomb Station

- Holcomb Station maintains an annual average NOx emissions rate of about 0.27 lb/MMBtu. Current Low-NOx burners have deteriorated, require increased maintenance, and may be less effective at efficient combustion control.
- There are concerns that regulations on NOx emissions reductions may become more stringent to levels of 0.15 to 0.22 lb/MMBtu in current NSPS for utility boilers.
- Installation of Integrated Combustion Optimization System offers Holcomb Station ability to achieve NSPS performance levels at a cost substantially less than EPA's technology of choice, SCR.



Competing Technology Options

- **SCR Technology**



Estimated NO_x Reductions in National Pollution Emissions from Commercialization

	Emissions Reductions, tons/year	Current NO_x Emissions from all Coal-fired Boilers in United States, tons/year
NO_x	45,670 <small>Basis: Technology market penetration of 8.4 GW_e</small>	4,611,943 <small>Basis: EPA 2000 NO_x tons</small>



Additional National Benefits from Commercialization



- **Integrated Combustion Optimization System technology could save from \$252 million to \$674 million in capital costs when compared to installation of SCR technology to achieve comparable NO_x emissions on 8.4 GW_e of existing power plants.**

Benefits of Technology for Holcomb

	Total NOx Emissions, tons/year
Before Retrofit	3,720
After Retrofit	2,000
Emissions Avoided	1,720

Total NOx Emissions at Holcomb Station are estimated to decrease by about 50% due to installation of Integrated Combustion Optimization System Technology.



Additional Benefits for Holcomb

- **Integrated Combustion Optimization System technology is estimated to save about \$30 million in capital costs and for operating cost, which are nominal, about \$1,000,000/year when compared to installation of an SCR system at Holcomb plant.**



Approach to Estimating Benefits

- Forecast market penetration.
- Quantify differences between performance of conventional SCR technology and anticipated performance of Integrated Combustion Optimization System being demonstrated.
 - Pollutant emissions, tons per year
 - Capital cost, constant dollars
 - Operating costs



Assumed Market Penetration

- Individual boilers most likely to install Integrated Combustion System Optimization Systems were selected from NETL Coal Power Data Base.
- These target boilers were selected based on specific attributes that made them most likely to benefit from this technology.
 - Equipped with low-NO_x Burners
 - Use of Subbituminous coal
 - Current NO_x emissions rates such that 50% reduction would result in emission rates between 0.15 and 0.22 lb/MMBtu



Assumed Market Penetration (continued)

- 56,145 MW_e of total market potential, which represents 133 boilers.
- Assumed market penetration of 15% resulting in 8,422 MW_e of existing power plants selected, which represents 20 boilers.



Differences in Performance

- Total NO_x Emissions-

- Total NO_x emissions currently emitted by individual boilers most likely to install this technology were calculated using NETL Coal Power Data Base.
- Total NO_x emissions after installation of this technology on these boilers were estimated by taking 50% of the current emissions of these selected boilers, but setting a lower limit of 0.15 lb/MMBtu if calculated values were below this level in accordance with the technology limitations.



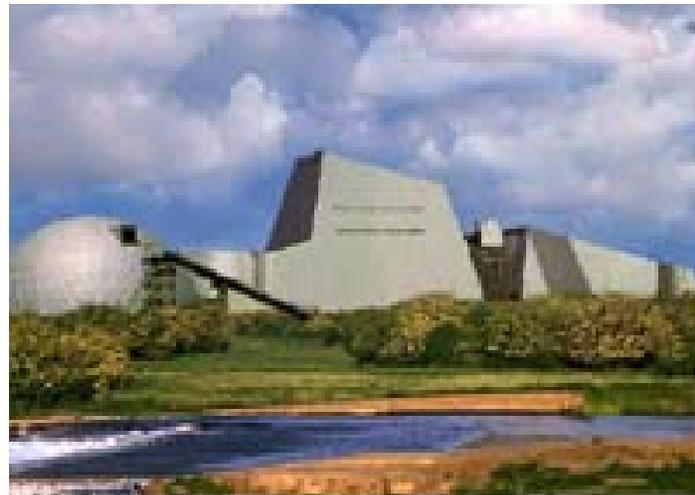
Differences in Capital Cost

- For this analysis, capital cost to install Integrated Combustion Optimization System technology at an existing power plant is estimated to be \$20 per kW.
 - Estimated installation cost at Holcomb is lower
- Capital cost of installing an SCR system for achieving same level of performance is estimated to be \$50 to \$100 per kW.
 - Based on engineering judgment
- Cost savings associated with Integrated Combustion Optimization System technology is difference between these costs multiplied by assumed market penetration (8.4 GW_e of existing coal-fired capacity).



Conclusions

- **There are significant benefits to nation that will be realized by commercialization of technologies being demonstrated in Power Plant Improvement and Clean Coal Power Initiatives.**



**Visit NETL web site for information on all Power
Plant Improvement Initiative and
Clean Coal Power Initiative projects.**

**[www.netl.doe.gov/
coalpower/ccpi](http://www.netl.doe.gov/coalpower/ccpi)**

