SynCoal Technology Economically Reduces Emissions While Optimizing Existing Generating Capacity

I. Mintzer* and R. Sheldon**

*Potomac Energy Fund, 5 South Market Street, Frederick, MD, USA, Irv.Mintzer@gmail.com
**SynCoal Solutions, Inc., Centennial, CO, USA, Ray.Sheldon@SynCoalSolutions.com

ABSTRACT

SynCoal Solutions, Inc. has developed the second generation of its patented, advanced coal-cleaning technology, the Gen2 System. This promising new technology, installed at the coal user's site, converts low-rank domestic coal into SynCoal®, a clean, engineered bituminous fuel, for use by the host customer and the surrounding industry. SynCoal® significantly reduces environmental releases of criteria pollutants and air toxics compared to burning untreated coal. The customer and industry also benefit from a wider range of coal sourcing opportunities, improved combustion, increased efficiency, reduced gas flow, lower draft losses, and fewer ash-related impacts. This paper provides a review of the status of SynCoal's Gen2 System and its national emissions reduction potential. It also highlights policy changes that are needed to unlock the value of America's vast resources of low-rank coals and release these resources to help protect our nation's economy as well as the global environment.

Keywords: syncoal, precombustion, emissions reductions, efficiency improvements

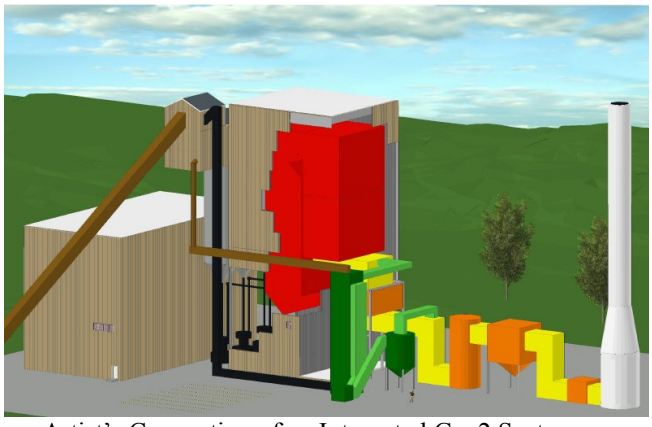
1 INTRODUCTION

SynCoal Solutions' Gen2 technology can economically convert Powder River Basin (PRB) coals into a high-value, engineered bituminous fuel that burns cleaner than other commercially available bituminous coals today. Among the group of pre-combustion coal upgrading technologies currently being offered, SynCoal Solutions has the most real-world production and application experience. The fuels produced by these technologies can improve coal-fired plant efficiencies and reduce emissions without major capital intensive retrofits to the existing fleet of power generators. Upgrading PRB coals to SynCoal®, when used with current control technologies can immediately reduce overall emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), particulate (PM), carbon dioxide (CO_2) and air toxics such as mercury (Hg). At the same time, this innovative technology increases the efficiency and capacity of existing coal-fired plants.

SynCoal Solutions is the successor to a Clean Coal Technology partnership formed in 1990 between the U.S. Department of Energy, Montana Power and Northern States Power. The partnership invested $105 million in the technology over the following 11 years building and operating a mine mouth demonstration plant at Colstrip, Montana.[1] By burning SynCoal® in a wide variety of utility and industrial applications, we learned from real-world experience how to make a clean engineered bitumionous fuel and how to handle it safely. SynCoal Solutions is the only coal upgrading company to produce and sell nearly two million tons of upgraded clean coal.

2 SYNCOAL GEN2 DEVELOPMENT

SynCoal's Gen2 System has been re-engineered from the Advanced Coal Conversion Process that was originally developed as a mine-mouth technology. The advancements made by SynCoal Solutions over the past three years to the Gen2 System still provide the same high quality SynCoal® but dramatically reduce the capital and operating costs to upgrade low-rank coal feedstocks. The re-engineered process is more efficient overall and has less environmental impact thanks to a patent pending non-fluidized tower heat recovery system at the end users' site. The integrated, totally enclosed, Gen2 System eliminates problems of dustiness and spontaneous combustion while minimizing processing energy consumption. The Gen2 System, can remove as much as 95 percent of the coal's moisture while selectively liberating mineral matter. If an unacceptable amount of mineral matter is present, it can be efficiently removed before the SynCoal® is combusted. These dry naturally occuring minerals (when removed) are the only effluent from the Gen2 System and can be safely disposed of in a conventional dry landfill.



Artist's Conception of an Integrated Gen2 System

3 POTENTIAL IMPACTS

In the simplest configuration, the Gen2 System can upgrade high-moisture coals prior to combustion in order to achieve optimum performance in existing facilities. SynCoal's Gen2 System can treat a wide range of low-rank feedstocks, from ultra-low sulfur, low ash, PRB sub-bituminous coals to dirtier, higher sulfur, higher ash lignites. SynCoal's Gen2 System removes up to 95% of the moisture from the raw feedstock, selectively liberating mineral matter and can remove these natural mineral impurities as a dry solid that is suitable for landfill, if that is economically advantageous. SynCoal®, the remaining clean coal product, is a consistent, drier, cleaner, engineered bituminous fuel that can be optimally tailored to the customer's requirements. Using SynCoal® in coal-fired processes increases overall thermal efficiency, provides enhanced combustion, and decreases the quantity of fuel-bound pollutants while providing increased fuel sourcing and purchasing flexibility throughout the remaining life of the host facility. The Gen2 System can be applied to power plants, gasification projects, cement factories, and steel mills.

SynCoal Solutions' Colstrip experience, including nine years of production with a Montana sub-bituminous feedstock and full scale testing with North Dakota lignite, created significant improvements to the fuel:

- Moisture reduced up to 95% with product moistures as low as 2%,
- Heating values increased up to 10,600 to 12,000 Btu/lb
- Sulfur contents reduced by 40% to 47%
- Ash contents reduced by 19% to 25%

Subsequent testing with Montana lignite and sub-bituminous coals demonstrated precombustion mercury reductions of 20% to 41% associated with pyrite removal.

Full-scale, side-by-side combustion comparisons between Montana sub-bituminous and a SynCoal® blend indicated that Btu for Btu, SynCoal®:

- Improved net plant heat rate by 8.8%
- Increase net generation by 29%
- Reduced SO_2 emissions per MBtu by 49%

4 ECONOMIC REPLACEMENT

A SynCoal® cost estimate was developed using 2007 EIA coal delivery data[2] for each state that had used Wyoming coal. This estimated SynCoal® cost was compared against the average delivered cost from each other state. If the SynCoal® cost was less, that coal was selected for potential economic replacement. Eleven states had bituminous coal deliveries that met this criteria.

As shown in Table 4.1, a total of 76 million tons of bituminous coal could be economically displaced. This represented 21% of the total 366 million tons consumed in those states in 2007, with a potential annual costs savings of over $520 million.

Table 4.1 Coal Displacement Potential

State	Total Tons (1000s)	Potential Replacement	Savings ($1000s)
Alabama	37,887	16,363	$ 94,854
Georgia	41,679	26,317	$ 212,027
Iowa	22,592	938	$ 21,286
Kentucky	40,063	6,783	$ 11,402
Michigan	37,014	8,403	$ 67,320
Minnesota	19,883	194	$ 6,680
Mississippi	9,964	2,582	$ 9,410
Missouri	45,843	1,759	$ 17,769
Ohio	58,372	142	$ 404
Tennessee	29,447	10,741	$ 46,962
Wisconsin	23,364	1,902	$ 32,889
Total	366,108	76,124	$ 521,003

Table 4.2 shows that if SynCoal® economically displaced all 76 million tons of coal identifed above, approximately 567,000 fewer tons of SO_2 would have been released by coal combustion in 2007, even without the optional removal of additional mineral matter.

Table 4.2 Potential SO_2 Reduction Prior to Post Combustion Controls

State	Pre Control Tons of SO_2 (1000s)	SO_2 Reduction Potential	%
Alabama	334,713	105,755	32%
Georgia	325,010	175,589	54%
Iowa	91,519	17,338	19%
Kentucky	887,632	68,068	8%
Michigan	201,948	71,160	35%
Minnesota	89,772	1,084	1%
Mississippi	58,316	7,790	13%
Missouri	173,963	32,192	19%
Ohio	993,059	103	0%
Tennessee	341,369	82,005	24%
Wisconsin	83,802	6,479	8%
Total	3,581,104	567,563	16%

Clean Technology 2009, www.ct-si.org, ISBN 978-1-4398-1787-2

Again if SynCoal® economically displaced all 76 million tons of coal identifed above, approximately 2.4 million fewer tons of ash would have been produced by coal combustion in 2007 as shown in Table 4.3. This would have helped reduce particulate emissions, boiler erosion, boiler outages and landfill airspace use .

Table 4.3 Potential Ash Reduction Prior to Combustion

State	Pre Control Tons (1000s)	Displacement Potential	%
Alabama	3,023,383	469,422	16%
Georgia	3,488,532	1,002,022	29%
Iowa	1,183,821	18,318	2%
Kentucky	4,222,640	285,458	7%
Michigan	2,191,229	160,555	7%
Minnesota	1,350,056	3,320	0%
Mississippi	1,161,802	99,453	9%
Missouri	2,406,758	25,983	1%
Ohio	5,685,433	4,011	0%
Tennessee	2,511,829	334,960	13%
Wisconsin	1,271,002	41,710	3%
Total	28,496,484	2,445,211	9%

5 IMPROVED EFFICIENCY

Additionally, SynCoal's Gen2 System has great potential to be used in power plants throughout the United States in addition to the improvements shown in section 4 for plants currently firing bituminous coals. Plants that consume both lignite and subbituminous coals could use Gen2 installations to upgrade their fuel resource and improve efficiency and environmental performance as was demonstrated in Colstrip.

EIA reports that as of January 1, 2007, 473 generators totaling 132 gigawatt of nameplate generation capacity, used sub-bituminous coal as their primary fuel.[3] U.S. sub-bituminous coal production has increased from 224.3 million tons in 1990 to 530.6 million tons in 2007[4] while only 16 sub-bituminous fueled plants, with a total capacity of 2.4 gigawatts were added, implying that over 80 gigawatts of existing capacity (calculated using the national average 10,200 Btu/kWh heat rate and 72% capacity factor from the 2007 EPA data [5]) switched to sub-bituminous coal between 1990 and 2007.

Most of this 80 gigawatts of capacity was probably previously fired with bituminous coal. If the efficiency improvements and emision reductions seen with SynCoal Solutions' Colstrip experience on a plant designed for sub-bituminous coal could be repeated on 60 of the 80 gigawatts converted to sub-bituminous coals (providing a generous allowance for conversion of previously lignite-fired plants), the Gen2 System could significantly further reduce air emissions in the United States. Potential reductions in emissions from the combustion of 60 gigawatts of sub-bituminous coals per year – in addition to the potential reductions shown in section 4 – are estimated as:

- 477,000 tons of SO_2
- 56,000 tons of NO_x
- 40.2 million tons of CO_2
- 8,900 pounds of mercury.

6 POLICY SHORTFALL

Coal-fired power plants provide almost half of the U.S. electricity. Pollution-control technology has reduced U.S. coal-fired utility emissions of the five criteria pollutants, CO, VOCs, SO_2, NO_x and particulate matter, by over 77% per kWh since 1970.[6] From a cost perspective, it make strong economic sense for the U.S. to continue building more coal plants, with state-of-the-art scrubbers to reduce the emissions of the criteria pollutants and mercury included. Despite increasing rhetoric about the need for energy independence and calls to fight the economic scourge of importing foreign oil, the fact that statistically the U.S. is the Saudi Arabia of coal can not overcome the regulatory uncertainties. These uncertainties, relate to the viability of maintaining operating permits, future mercury and carbon control requirements and limitations on plant maintenance and retrofit opportunities, have imposed a near total ban on new coal-fired power plants in the U.S. despite steadily increasing electricity demand. Numerous studies have found that a nation's wealth and well being are closely related with per capita energy use and electricity consumption. Our economic growth and national security has been and will continue to be dependent upon the development of affordable, environmentally compatible electrical generation. As U.S. electricity demand continues to grow, a 120 gigawatt shortfall in supply is projected by 2016.[7] Where will the new supplies come from?

Increasing use of renewable sources like solar and wind are likely to supply a small but significant part of the overall electricity supply mix in the near-term. Barring a major breakthrough in large-scale electricity storage technology, these renewable sources will necessarily have to be paired with conventional dispatchable power plants to ensure reliable grid operation. The U.S. has benefited from the shift to more renewable sources over the past few years largely by using our reserve margins and building more gas-fired generation facilities. This, in turn, has increased natural gas-fired electricity production to over 21% of our electric supply in 2008.[8] Since 1998, natural gas demand

in the power sector has increased by about 50 percent. During the same time frame, natural gas prices have nearly quadrupled,[9] dramatically increasing the clearing price of electricity inspite of a rapid growth in U.S. gas supplies. This recent growth in domestic natural gas supply may not be sustained due to environmental concerns about both gas-fired facilities and development of new natural gas production wells. Thus, high reliance on natural gas increases the risk of physical supply and delivery interruptions and could expose exposuring the electricity consumers to likely price shock impacts.

Ironically, many coal-fired utility plants could economically increase their available electricity supply from existing facilities while decreasing the overall emissions per kWh, but they chose to follow a "do nothing" approach. This has been partly due to a lack of certainty about economic conditions and environmental regulation along with the possibility of retroactive penalties for "not doing enough." These uncertainties have pushed the electric utility industry, with the support of the regulators, into relatively short-term resource planning and acquisition, and increasing the electricity consumers reliance on unspecified, undeveloped, or uncommitted resources to meet their future electricity needs.

7 POTENTIAL SOLUTION

The current policy shortfall could be largely overcome and near-term, economical additions to our nation's baseload electric supply could be stimulated by a policy clarification involving the rules that will be applied to retrofit projects. Retrofit projects could be defined as those capital projects designed to improve the overall productivity, energy efficiency and environmental performance per kWh of electricity from existing facilities. Clarifying the rules for New Source Review (NSR) and New Source Performance Standards (NSPS) so that retrofit projects could be permitted as modifications to existing sources would be extremely helpful. These rules could include environmental performance metrics evaluated on a per unit of electricity basis and could provide assurance that such permits would remain valid for a period of at least 10 years. In that case, the rules would provide the regulatory certainty sufficient to stimulate economic investments in these projects and would result in significant increases in baseload electric supplies while reducing emissions of coal-related pollutants.

This policy approach would allow utilities and regulators to aggressively pursue the rapid implementation and economical use of pre-combustion technologies, like SynCoal's Gen2 System, and would stimulate our economy, help meet our increasing demand for reliable and affordable baseload electricity generation while reducing coal-fired emissions.

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