The Value of Coal Combustion Products:

An Economic Assessment of CCP Utilization for the U.S. Economy

Revised Second Edition

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Executive Summary

Coal Combustion Products (CCPs) – including fly ash, bottom ash, and flue gas desulfurization (FGD) material – represent a strategic resource for the United States that has been steadily growing in utilization since the 1950s.

CCPs are produced during the generation of electricity at coal-fueled power plants. In 2008, 136.1 million tons of CCPs were produced in the United State – of which 44.5% was utilized in a beneficial manner. The largest portion was fly ash, accounting for 72.5 million tons, 41.6% of which was beneficially used.

This study identifies the following annual economic benefits from the utilization of these materials as an alternative to disposing of them as waste:

Revenues from the Sale of CCPs for Utilization	$ 1,028,761,000
Avoided Costs of Disposal	$ 412,800,000
Savings from Use as Sustainable Building Materials	$ 5,000,000,000 to $10,000,000,000

Total Economic Impact: $6.4 billion to $11.4 billion

Utilization of CCPs also creates significant benefits in the form of improved performance for products incorporating them.

Utilization of CCPs also creates significant annual environmental benefits such as the reduction in energy consumption commensurate with the energy consumed by 1.7 million homes, water savings equal to 31% of the annual domestic water use in California, and reductions in greenhouse gas emissions comparable to removing 2 million automobiles from the roadway.

The remainder of this study discusses the history, characteristics, production and handling of coal combustion products. It includes descriptions of the myriad beneficial uses and product standards for the materials.

Finally, this study discusses the outlook for future utilization of this resource based on emerging technology and regulatory factors that could help – or harm – one of the nation's largest recycling success stories.

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Section 1 - Introduction

Coal Combustion Products (CCP) use gradually evolved into a multi-billion dollar industry in the United States without fanfare as the result of regulatory, technical and market-based developments. Whether the industry will continue to grow is a function of how well those three legs of the stool remain balanced.

In 2005, the American Coal Council published the first detailed analysis of the economic scope of the coal ash industry. That 128-page report was a snapshot of the coal ash industry largely based on 2003 data concerning the production and use of fly ash, bottom ash, boiler slag and synthetic FGD gypsum. The study identified more than $2.2 billion in annual direct economic impact from the use of these products in a variety of construction and manufacturing applications, as well as a total economic impact of nearly $4.5 billion annually.

This publication is an updated and expanded version of that report, incorporating the most up-to-date production and use statistics for 2007 and 2008 and featuring expanded analysis of how the coal ash industry got to where it is and what the future may have in store.

The first uses of coal ash as a construction material occurred in the United States beginning in the 1940s. Engineers with the U.S. Bureau of Reclamation were seeking a way to mitigate the heat of hydrating cement in mass concrete placements such as dams. Construction of the Hungry Horse Dam in Montana beginning in 1948 utilized 120,000 tons of coal fly ash. Six more dams utilizing coal fly ash were built during the 1950s.

Increasing environmental regulations in the 1960s, culminating with the Clean Air Act of 1970, forced electric utilities to begin collecting substantially all of the fly ash produced by coal combustion. Utilities initially moved to dispose of substantially all of the ash, but drawing on the Bureau of Reclamation's experience, an ash marketing industry emerged to begin utilizing the resource for construction materials. The National Ash Association – forerunner of the current American Coal Ash Association – was organized in 1968.

Over the four decades commencing in 1966, utilization of coal ash increased steadily. Utilization increases have been attributed to advances in technological knowhow, education of users and specifiers of construction materials, and development of logistics resources to deliver materials to markets.

Utilization rates of coal ash increased more dramatically beginning in 2000. That year, the U.S. Environmental Protection Agency issued its Final Regulatory Determination that coal ash did not warrant regulation as a hazardous waste, concluding more than 20 years of study and prior rulings on the topic. Since that Final Determination was issued in 2000, utilization rates for coal ash have increased from 30% to 43% – a growth rate made even more impressive by a steadily increasing volume of coal ash supply.

The industry's ability to continue increasing the amount of coal ash used beneficially as an alternative to disposal may not be assured, however. New technical and regulatory developments are serving to both encourage and potentially discourage utilization.

Technically, the coal ash universe is expanding as never before. In the early days of coal ash industry history, the technical focus was largely on demonstrating the material's usefulness as a component of construction materials and on establishing standards for its composition. Today, coal ash users are exploring techniques for utilizing increasingly higher quantities of ash. Meanwhile, a new industry segment has emerged to supply technologies to coal ash producers to help them improve and maintain the quality of material bound for utilization.

On the regulatory front, a mixed bag of incentives and disincentives may be facing the industry. On the plus side, national climate change legislation is expected to establish ambitious targets for reducing greenhouse gas emissions. Utilization of coal fly ash as a partial replacement for cement in producing concrete is an important contributor to this goal. More than 15 million tons of carbon dioxide emissions from cement production were avoided in 2007 alone through the use of coal ash.

On the negative side, however, the EPA has indicated that it may rescind its Final Regulatory Determination of 2000 and seek to regulate coal ash as a hazardous waste when disposed. Although EPA has indicated that it intends to continue supporting beneficial uses of coal ash such as fly ash in concrete, the mixed regulatory signals – hazardous for disposal, but not hazardous for use in concrete in your neighborhood – could seriously harm continued utilization of the resource.

Terminology

The term "Coal Combustion Products" or "CCP" is used throughout this report to refer to the class of materials produced when burning coal, chiefly for the purpose of generating electricity. Often referred to generically in the news media as "coal ash," these materials do include fly ash and bottom ash. But CCP also refers to non-ash products of combustion, including boiler slag and the output of Flue Gas Desulphurization equipment used to control emissions.

In addition to the generic term "coal ash," CCP is sometimes referred to by other terms. "Coal Combustion Wastes" (CCW) and "Coal Combustion Byproducts" (CCB) are two terms that occur frequently in historical records of the CCP industry and remain in use by some government agencies. Also, personnel of the U.S. Environmental Protection Agency have recently begun referring to the materials as "Coal Combustion Residues" (CCR) in documents related to development of new disposal regulations.[1]

[1] http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=200904&RIN=2050-AE81

However, U.S. EPA continues to refer to the materials as Coal Combustion Products in the agency's Coal Combustion Products Partnership (C2P2) program, which was created to encourage increased utilization as an alternative to disposal. Inasmuch as the utilization of CCP is the prime focus of this report, the CCP terminology is adopted throughout.

Data Sources

This report utilized data from numerous sources, most of which are footnoted at the appropriate section of the report. Key data sources include:

- U.S. Department of Energy, Energy Information Administration
- U.S. Environmental Protection Agency
- U.S. Department of Transportation, Federal Highway Administration
- American Coal Ash Association
- Electric Power Research Institute
- Portland Cement Association

Baseline data for the 2005 edition was largely obtained from *EIA 767* annual reports for 2001, 2002 and 2003. The Energy Information Administration has since terminated the Form EIA-767. Beginning with calendar year 2007 data, two other surveys, the Form EIA-860 (Annual Electric Generator Report) and the Form EIA-923 (Power Plant Operations Report), began collecting most of the data formerly collected on the Form EIA-767. The New Form EIA-923 combined:

Form EIA-906 - Power Plant Report
Form EIA-920 - Combined Heat and Power Plant Report
Form EIA-423 - Monthly Cost and Quality of Fuels for Electric Plants
FERC Form 423 - Monthly Report of Cost and Quality of Fuels for Electric Plants
Form EIA-767 - Steam-Electric Plant Operation and Design Report

Utility CCP Revenues – Obtained from *EIA 767* annual reports for 2001, 2002 and 2003 and from *EIA 923* annual report for 2007. No assumptions were made for revenues; actual reported values were utilized. Revenues reported as "Fly Ash / Bottom Ash Intermingled Revenues" were proportionately distributed to the fly ash and bottom ash categories.