

SUBTASK 2.6 – ASSESSMENT OF ALTERNATIVE FUELS ON CO₂ PRODUCTION

Final Report

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SUBTASK 2.6 – ASSESSMENT OF ALTERNATIVE FUELS ON CO₂ PRODUCTION

ABSTRACT

Many coal-based electric generating units use alternative fuels, and this effort assessed the impact of alternative fuels on CO₂ production and other emissions and also assessed the potential impact of changes in emission regulations under the Clean Air Act (CAA) for facilities utilizing alternative fuels that may be categorized as wastes.

Information was assembled from publicly available U.S. Department of Energy Energy Information Administration databases that included alternative fuel use for 2004 and 2005. Alternative fuel types were categorized along with information on usage by coal-based electric, number of facilities utilizing each fuel type, and the heating value of solid, liquid, and gaseous alternative fuels.

The sulfur dioxide, nitrogen oxide, and carbon dioxide emissions associated with alternative fuels and primary fuels were also evaluated. Carbon dioxide emissions are also associated with the transport of all fuels. A calculation of carbon dioxide emissions associated with the transport of biomass-based fuels that are typically accessed on a regional basis was made.

A review of CAA emission regulations for coal-based electric generating facilities from Section 112 (1) and Section 129 (2) for solid waste incinerators was performed with consideration for a potential regulatory change from Section 112 (1) regulation to Section 129 (2). Increased emission controls would be expected to be required if coal-based electric generating facilities using alternative fuels would be recategorized under CAA Section 129 (2) for solid waste incinerators, and if this change were made, it is anticipated that coal-fired electric generating facilities might reduce the use of alternative fuels.

Conclusions included information on the use profile for alternative fuels and the impacts to emissions as well as the impact of potential application of emission regulations for solid waste incinerators to electric generating facilities using alternative fuels.

REFERENCES

1. Clean Air Act, Section 112. www.law.cornell.edu/uscode/html/uscode42/usc_sec_42_00007412----000-.html (accessed Jan 5, 2009).
2. Clean Air Act, Section 129. www.law.cornell.edu/uscode/html/uscode42/usc_sec_42_00007429----000-.html (accessed Jan 5, 2009).

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NOMENCLATURE

CAA	Clean Air Act
DOE	U.S. Department Of Energy
EERC	Energy & Environmental Research Center
EIA	Energy Information Administration
EPA	U.S. Environmental Protection Agency
RCRA	Resource Conservation and Recovery Act
SWDA	Solid Waste Disposal Act
TDF	Tire-derived fuel
USWAG	Utility Solid Waste Activities Group

SUBTASK 2.6 – ASSESSMENT OF ALTERNATIVE FUELS ON CO₂ PRODUCTION

EXECUTIVE SUMMARY

Many coal-based electric generating units use alternative fuels such as tire-derived fuel (TDF), waste biomass, used oil, and other recovered materials. The advantages of using these fuels include the recovery of energy from otherwise potentially wasted materials and the potential to reduce CO₂ and other emissions. The effort undertaken at the Energy & Environmental Research Center (EERC) assessed the impact of alternative fuels on CO₂ production and other emissions through the following activities:

- Assembly of information on the types and volumes of supplementary fuels used by U.S. coal-fired electric generators.
- Assembly of information on the units and boiler types where supplementary fuels are used.
- Determination of the CO₂ production, sulfur dioxide, and nitrogen oxides associated with alternative fuel use at coal-based electric generating facilities.
- Development of a carbon footprint associated with biomass use at a small electric generating facility.
- Assessment of the impacts to supplementary fuel usage if electric generators are subjected to more stringent emission regulation under Clean Air Act (CAA) Section 129 developed for solid waste incinerators (1).

U.S. Department of Energy (DOE) Energy Information Administration (EIA) 860 and 767 (2, 3) databases with alternative fuel use information for 2004 and 2005 were accessed and reviewed to determine what information on alternative fuels, combustion configuration, and emission controls was available from these resources. Alternative fuel types were categorized, and Table ES-1 shows alternative fuel types, the number of facilities utilizing each fuel type, and the heating value of solid, liquid, and gaseous alternative fuels.

The emissions associated with alternative fuels were evaluated, and Figure ES-1 shows the sulfur dioxide, nitrogen oxide, and carbon dioxide emissions associated with alternative fuels and primary fuels for comparative purposes. Biomass-based alternative fuels are considered to exhibit a net-zero carbon dioxide emission, while all other fuels emit some carbon dioxide. Carbon dioxide emissions are also associated with the transport of all fuels. A calculation of carbon dioxide emissions associated with the transport of biomass-based fuels that are typically accessed on a regional basis was made. Because the distance for transport of biomass-based alternative fuels was expected to be relatively short, the carbon dioxide emissions associated with transport of biomass-based fuels is expected to be lower than some other primary or alternative fuels transported using the same mode of transport.

Table ES-1. Alternative Fuels Used by Coal-Based Electric Generating Units in 2005

Alternative Fuel	Number of Units Reporting Use of the Fuel	Heating Value
Solid Fuels, Btu/lb		
Ag. By-Product	3	6365
Biomass Solids	1	5000
Municipal Solid Waste	5	5899
Petroleum Coke	57	13,524
Sludge Waste	6	4099
Tire-Derived Fuel	40	14,951
Waste Coal	25	6470
Wood Solids	37	5691
Liquid Fuels, Btu/gal		
Residual Fuel Oil	29	149,411
Waste Oil	9	121,711
Gaseous Fuels, Btu/ft³		
Biomass Gas	2	581
Landfill Gas	7	504

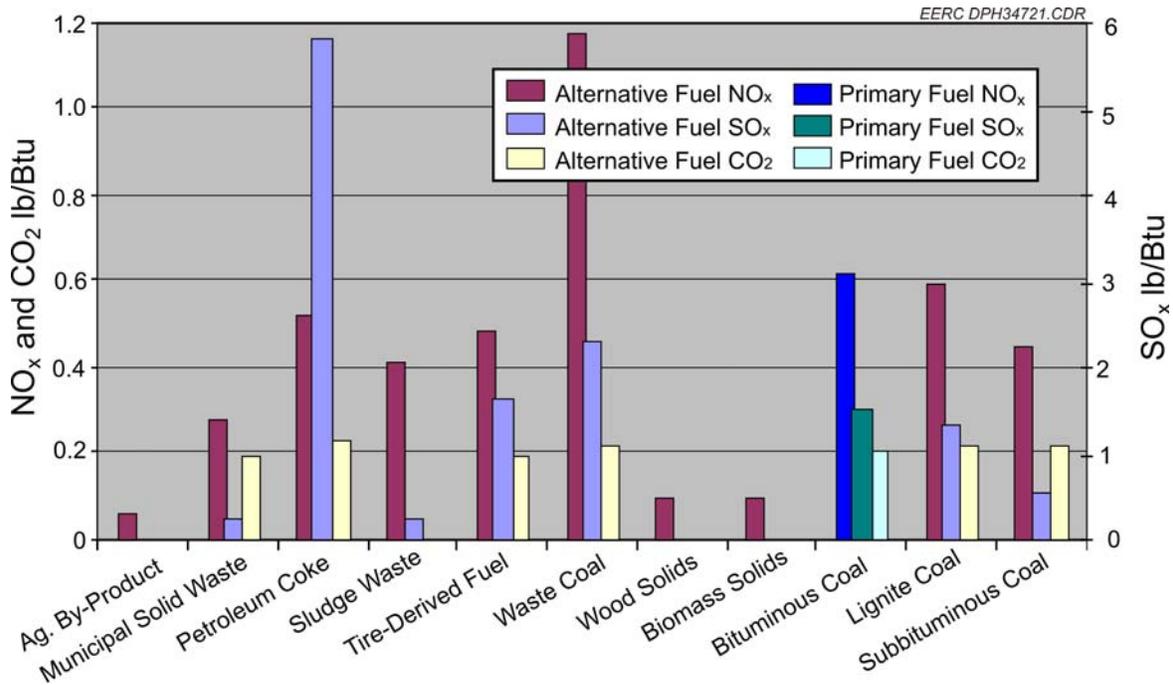


Figure ES-1. 2005 calculate emissions for solid alternative fuels.

A review of CAA emission regulations for coal-based electric generating facilities from Section 112 (4) and Section 129 (1) for solid waste incinerators was performed. Increased emission controls would be expected to be required if coal-based electric generating facilities

using alternative fuels would be recategorized under CAA Section 129 (1) for solid waste incinerators, and if this change were made, it is anticipated that coal-fired electric generating facilities might reduce the use of alternative fuels.

Based on the information assembled, the following conclusions were drawn:

- Alternative fuels are used broadly by coal-based electric generating facilities across the United States.
- Data imply that many alternative fuels are “opportunity fuels” and their use is based more on availability than on economic or environmental factors.
- Solid alternative fuels, with the exceptions of petroleum coke and waste coal, result in reduced sulfur dioxide, nitrogen oxide, and carbon dioxide emissions on a Btu basis as compared to coal.
- Biomass-based alternative fuels are considered carbon neutral but also are expected to have a smaller carbon footprint related to transport compared to other primary and alternative fuels.
- Changes in CAA emission regulation for coal-based electric generating facilities from Section 112 (4) to Section 129 (1) for solid waste incinerators should take into account the advantages of reduced emissions when alternative fuels are used to replace a percentage of fuel at coal-based electric generating units.

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SUBTASK 2.6 – ASSESSMENT OF ALTERNATIVE FUELS ON CO₂ PRODUCTION

INTRODUCTION

The use of alternative fuels to supplement coal at coal-based electric generating facilities has been investigated. The U.S. Department of Energy (DOE) and others have been involved in studies to encourage the generation of power from renewable energy through the demonstration of “coblending” of biomass in utility power boilers. This “cofiring” of the biomass feed with solid fossil fuel (coal) has demonstrated reduced sulfur and nitrogen, with perhaps the most significant environmental benefit being derived from potential CO₂ production/emissions. In addition to the cofiring of biomass from multiple sources, other alternative fuels are currently being cofired at coal-based electric generating units across the United States including tire-derived fuel and used oil. If these alternative fuels are used for electric generation in conjunction with coal-based fuels, the potential exists for reductions in CO₂ emissions from the facility. There is an added CO₂ benefit potentially realized from the reduction in transportation, which leads to reduced fuel consumption. Use of alternative fuels also has potential advantages in ensuring a fuel supply for U.S. electric generation. The full impact on the potential for CO₂ emission reductions from the use of alternative fuels at coal-based facilities is not well documented.

From a regulatory standpoint, the use of alternative fuels is also under review because certain of the alternative fuels may potentially be viewed as “solid wastes” under the Solid Waste Disposal Act (SWDA) or Resource Conservation and Recovery Act (RCRA). This is the case despite the fact that the term “solid waste” under RCRA only includes materials that are truly discarded as that term is commonly understood and does not include materials that are legitimately recycled or reused. If these alternative fuels are defined as solid wastes, facilities using them may be required to meet emission standards promulgated under the Clean Air Act (CAA) Section 129 (1) for “solid waste incineration units,” which are, in some respects, more stringent than those for boilers, cement kilns, and other industrial furnaces (“boilers/furnaces”) regulated under CAA Section 112 (2). A better understanding of the alternative fuels currently being used by coal-based electric generating facilities, their impacts on CO₂ production, the potential for alternative fuels to impact CO₂ capture technologies, and the potential impact to the use of alternative fuels if users are subjected to CAA Section 129 (1) regulation will provide information valuable to the coal-based utility industry and to industries that currently produce and supply alternative fuels to them.

BACKGROUND

Coal-based electric generating facilities frequently supplement their primary coal fuel with alternative or supplementary fuels. Information on these alternative fuels is collected by the DOE Energy Information Agency (EIA) and reported annually. From a regulatory perspective, in 2005, the U.S. Environmental Protection Agency (EPA) proposed that, when burned for energy, recovery-specific materials (i.e., biomass fuel, coal, natural gas, and oil) and other materials with a heating value of 5000 Btu/lb or more are not solid waste. EPA also determined that materials

combusted for the recovery of chemical constituents (i.e., pulping liquors, spent sulfuric acid, and wood and coal feedstock) are not being discarded and therefore are not solid waste (3). While EPA subsequently recognized that the efficiency of many combustion devices allows materials to be burned as fuels with Btu/lb values of less than 5000 (4), the fundamental principle recognized by the Agency was that materials burned for energy or chemical recovery should *not* be regulated as “solid wastes” for the purposes of CAA Section 129, because such materials have value as a fuel or a chemical feedstock and are not being discarded. This information indicates that at least some alternative fuels used by coal-based electric generators could be categorized as wastes but are not considered wastes because they are being used for energy recovery. Examples of these types of alternative fuels are municipal solid waste and agricultural crop waste. Some of the alternative fuels that might be considered wastes are liquids (sludge waste, waste oil). Wastes are also combusted in incinerators; however, the function of waste incinerators is to discard materials (waste) through high-temperature combustion, while the function of electric generating boilers/furnaces is to recover energy. Solid wastes are also defined under the SWDA or RCRA and only include materials that are truly discarded as that term is commonly understood. This does not include materials that are legitimately recycled or reused, such as secondary materials that are legitimately reused as fuels.

Coal-based electric generating facilities that also combust alternative fuels that might be considered wastes currently are categorized under Section 112 (2) of the CAA; however, the Utility Solid Waste Activities Group (USWAG) recently indicated to industry members that EPA is evaluating the potential for these facilities to be recategorized under CAA Section 129 (1), which requires more stringent air emission controls.

A review of the alternative fuels currently being used by coal-based electric generating facilities is needed in order to facilitate an understanding of the way coal-based electric generating facilities utilize these “fuels” and the impacts of these fuels on emissions. The impact of alternative fuels on CO₂ emissions is of high interest because the reduction of greenhouse gas emissions is a high priority, especially for the coal-based electric utility industry.

OBJECTIVES

The objective of this task is to assess the impact of the use of alternative fuels on CO₂ production at coal-based electric generating facilities. The supporting objectives are:

- To assemble information on the types and amounts of alternative fuels being used at coal-based electric generating facilities and the facility systems (boiler type, emission controls, primary fuel, etc.) that are currently using alternative fuels.
- To evaluate the CO₂ production associated with various alternative fuels and assess the broader carbon footprint of alternative fuels, including collection and transportation.
- To assemble information on the sulfur dioxide and nitrogen oxide emissions associated with alternative fuels.

- To assess the impacts on alternative fuel use if users are subjected to more stringent emission regulations under CAA Section 129.

EXPERIMENTAL METHODS

The work for this effort was accomplished in several activities as follows.

Activity 1 – Assembly of Information on Alternative Fuel Use

Using resources available through DOE EIA and industry, information was assembled on recent alternative fuel usage by coal-based electric generating units in the United States. The sources used were DOE EIA 767 and 860 (5, 6) data and the DOE EIA-published Electric Power Annual and Annual Energy Review. Information on the system types was also assembled from these resources. Information on the collection and transport of the alternative fuels to the user was also reviewed where available. Estimates of total quantities of alternative fuel types being used were made, and information on the system profiles of alternative fuel users was assembled and reviewed. Information pertinent to assessing the carbon footprint of the alternative fuels was sought through individual users as identified in the EIA 767 and 860 (5, 6) online databases.

Activity 2 – Determination of CO₂ Production and Other Emissions Associated with Alternative Fuels

Using information assembled from sources noted, a list of alternative fuels used by coal-based electric generating facilities was developed. Alternative fuels were categorized, ranges of carbon content for each category of fuel was collected from literature, and the theoretical maximum CO₂ production from alternative fuels was calculated. Other fuel properties, including heating value and potential for sulfur dioxide and nitrogen oxide production, were also determined. The emission factors used were found in the Electric Power Annual – 2000 (Volume II) (7) data tables. For coal (bituminous, subbituminous, lignite), the sulfur and nitrogen emission calculations were performed using weighted averages based on information for varying boiler types. For petroleum coke, a sulfur content of 6% was given in the Electric Power Annual. The NO_x production from residual fuel oil and natural gas was calculated using a weighted average based on boiler configuration. The biomass gas emissions were calculated assuming an average composition of 60% methane and 40% CO₂. A calculation of the carbon footprint associated with the use of biomass-based alternative fuel was made, focusing primarily on the transport of biomass to an electric generating unit.

Activity 3 – Determination of Regulatory Impacts to Alternative Fuel Usage

Emission regulations under CAA Section 129 (1) developed for solid waste incinerators were reviewed and compared to those under CAA 112 (2). A preliminary assessment of additional emission controls that might be required by alternative (waste) fuel users was made based on existing emission controls used by solid waste incinerators.

Activity 4 – Quarterly and Final Reports

Reporting included quarterly reports and a final report.

RESULTS AND DISCUSSION

Activity 1 – Assembly of Information on Alternative Fuel Use

DOE EIA 860 and 767 (6, 5) databases were accessed and reviewed to determine what information on alternative fuels, combustion configuration, and emission controls was available from these resources. It was found that information for 2007 was not yet available. It was also determined that the 2006 data were limited and did not include key information on alternative fuels required for this effort for 2006. It was then decided to limit the project to 2004 and 2005 data. Information from the two online databases was transferred into Excel spreadsheets and Access database manager to facilitate searches, data retrieval, and presentation. The number of facilities utilizing alternative fuels in 2005 was 212. Figure 1 shows the locations of electric generating facilities identified as users of alternative fuels in 2005. The number and locations of plants using alternative fuels was similar for 2004.

The categories of alternative fuels being used with coal were assessed. A list of alternative fuels reported by coal-based electric generating facilities with a nameplate capacity of 25 MW or greater and delivering power to the electric grid are noted in Table 1 for 2004 and Table 2 for 2005. The alternative fuels were categorized by solid, liquid, or gas, and the heating values of all

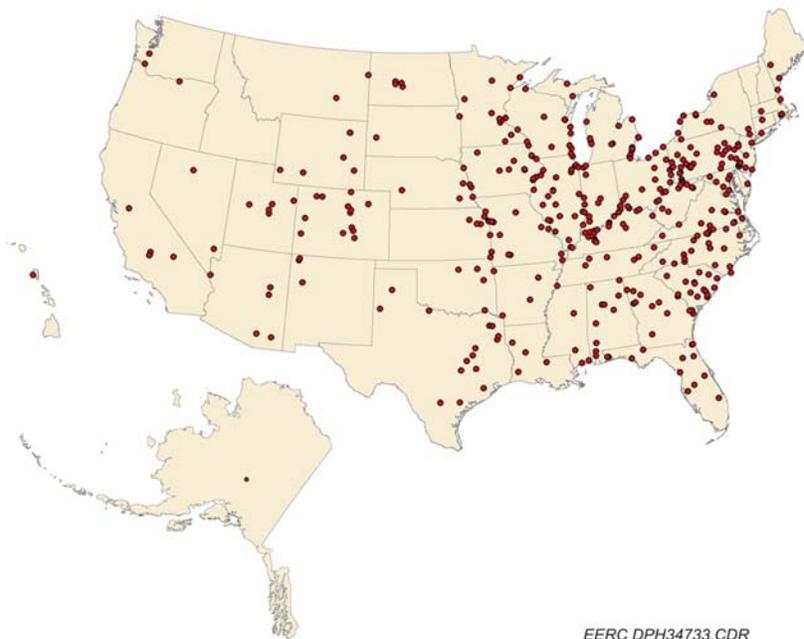


Figure 1. Locations of electric generating facilities using alternative fuels in 2005.

Table 1. Alternative Fuels Used by Coal-Based Electric Generating Units in 2004

Alternative Fuel	Number of Units Reporting Use of the Fuel	Average Heating Value
Solid Fuels, Btu/lb		
Ag. By-Product	4	6,297
Municipal Solid Waste	7	7,267
Petroleum Coke	52	13,668
Sludge Waste	5	3,546
Tire-Derived Fuel	36	15,022
Waste Coal	25	6,136
Wood Solids	40	5,940
Liquid Fuels, Btu/gal		
Biomass Liquid	1	124,800
Residual Fuel Oil	25	150,632
Waste Oil	14	125,844
Gaseous Fuels, Btu/ft ³		
Landfill Gas	35	6,646
Other Gas	1	504

Table 2. Alternative Fuels Used by Coal-Based Electric Generating Units in 2005

Alternative Fuel	Number of Units Reporting Use of the Fuel	Heating Value
Solid Fuels, Btu/lb		
Ag. By-Product	3	6,365
Biomass Solids	1	5,000
Municipal Solid Waste	5	5,899
Petroleum Coke	57	13,524
Sludge Waste	6	4,099
Tire-Derived Fuel	40	14,951
Waste Coal	25	6,470
Wood Solids	37	5,691
Liquid Fuels, Btu/gal		
Residual Fuel Oil	29	149,411
Waste Oil	9	121,711
Gaseous Fuels, Btu/ft ³		
Biomass Gas	2	581
Landfill Gas	7	504

alternative fuels were assembled. This information is also summarized in Tables 1 and 2. Additionally, the alternative fuels that might be considered wastes if they were not being used for heat recovery are noted in Tables 1 and 2.

The alternative fuel type of greatest interest is solid alternative fuels, primarily because of the issue of defining a material as a solid waste rather than a recovered material for energy

recovery. Figures 2 and 3 show the numbers of coal-based plants and units that used alternative fuels by alternative fuel type for 2004 and 2005 respectively. Similar information for liquid and gaseous alternative fuels is included in Appendix A.

The map shown in Figure 1 indicates that alternative fuels are being used by coal-based electric generating units across the United States but that it is more common in the eastern United States. Tables 1 and 2 provide a profile of alternative fuel use for 2004 and 2005. The alternative fuels that could be considered wastes fall into the solid and liquid alternative fuel categories. These are following:

- Agricultural by-products
- Biomass solids
- Municipal solid waste
- Sludge waste
- Waste coal
- Wood solids

The following are liquid alternative fuels that might be categorized as wastes:

- Biomass liquid
- Waste oil

Strictly applying the definition of alternative fuel for solids that indicates the material must have a heating value greater than 5000 Btu/lb, the alternative fuels identified as used by electric generators in 2004 and 2005 can be categorized as noted in Table 3.

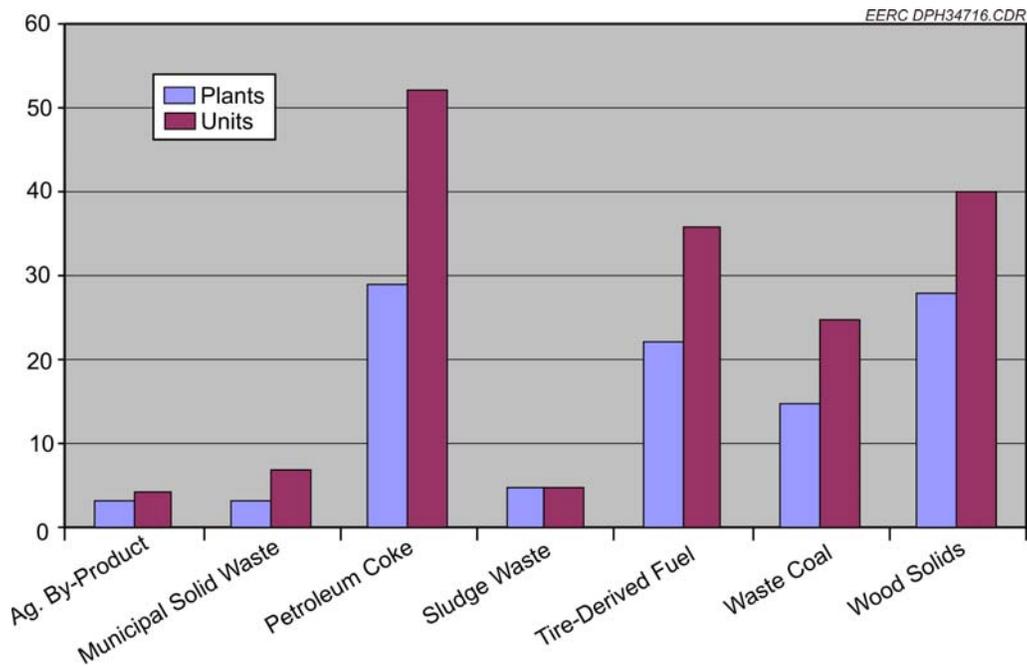


Figure 2. 2004 plants and units using alternative fuels.

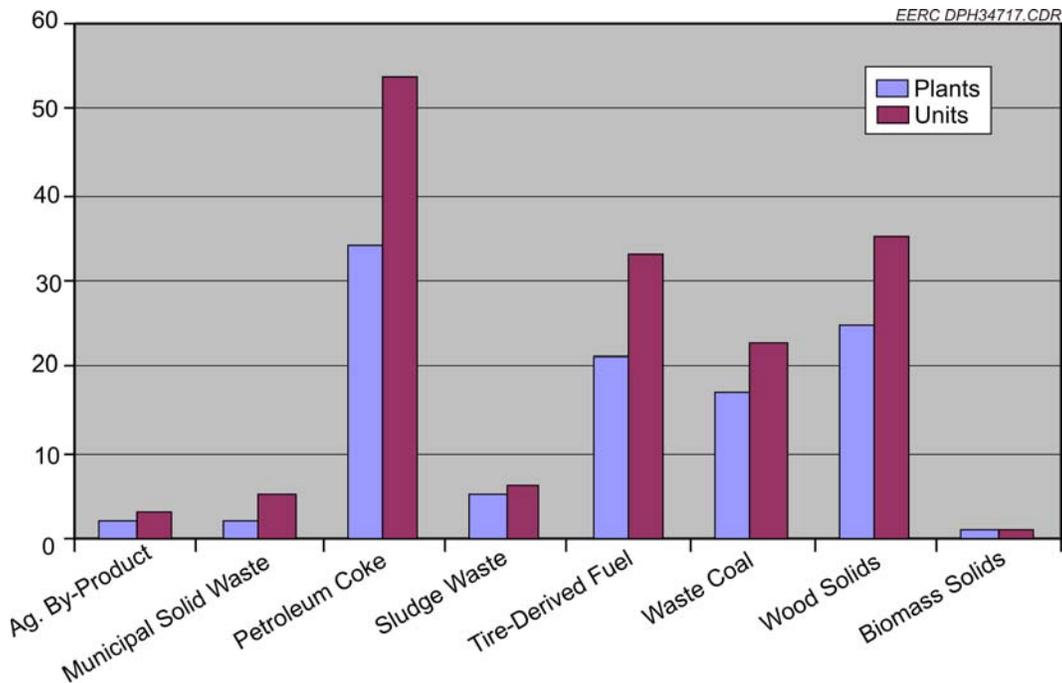


Figure 3. 2005 plants and units using alternative fuels.

Table 3. Categorization of Alternative Fuels as Wastes Based on Heating Value

Alternate Fuels That Could Be Categorized as Wastes			Alternate Fuels That Could Be Categorized as Wastes But with Heating Values >5000 Btu/lb		
Fuel	No. of Units	Heating Value	Fuel	No. of Units	Heat Generated
Sludge Waste	6	4099 Btu/lb	Waste coal	25	6,470 Btu/lb
			Petroleum coke	57	13,524 Btu/lb
			Agriculture crop by-products	3	6,365 Btu/lb
			Other biomass solid	1	5,000 Btu/lb
			Waste oil	9	121,711 Btu/gal
			Municipal solid waste	5	5,899 Btu/lb
			Tires	40	14,951 Btu/lb
			Wood waste solids	37	5,691 Btu/lb

For the purposes of the remainder of the work in this project, it was decided to further categorize alternative fuels based on consumption. The following fuels were considered primary fuels in determination of the impacts of alternative fuels on emissions because they are typically primary fuels or fuels used for start-up procedures at coal-based electric generating facilities:

- Bituminous coal
- Lignite coal
- Subbituminous coal
- Coal-based synfuel, including briquettes, pellets, or extrusion
- Distillate fuel oil
- Residual fuel oil
- Natural gas
- Propane

Activity 2 – Determination of CO₂ Production and Other Emissions Associated with Alternative Fuels

Using information assembled from sources noted, a list of alternative fuels used by coal-based electric generating facilities was developed. Alternative fuels were categorized, ranges of carbon content for each category of fuel were collected from literature, and the theoretical maximum CO₂ production from alternative fuels was calculated. Other fuel properties, including heating value and the potential for sulfur dioxide and nitrogen oxide production, were also determined using information from the 2004 and 2005 EIA 767 (5) forms and the Electric Power Annual – 2000 (Volume II) (7) data tables. Figures 4 and 5 show the amount of individual solid fuels used and heating values for 2004 and 2005. Similar information on liquid and gaseous fuels is included in Appendix A. Figures 6–11 provide information on the CO₂ production, SO₂, and NO_x emissions for solid, liquid, and gaseous fuels.

As shown in Figures 6 through 11, biomass-based alternative fuels are considered to emit no carbon dioxide on combustion. The reason for this is that these fuels are considered carbon neutral, which means they accumulate carbon dioxide during growth of the biomass (plant) and then release carbon dioxide on combustion resulting in a net-zero emission of carbon dioxide. In order for a material to have fuel value in conventional combustion systems, carbon must be present, so these alternative fuels do emit carbon dioxide. The carbon dioxide emissions are, however, considered to be zero. All fuels require some activity to access and prepare the fuel for use in conventional combustion systems. These activities include mining, transportation to the use site, and physical preparation to meet the needs of the combustion system. Biomass fuels generally require some handling, but most typically, the collection and processing/preparation is part of the process for the primary use of the biomass including crop processing for food and other products and wood processing for paper and other products. As shown in Figures 3 and 4, the use of wood waste as an alternative fuel for electric generation is relatively common. For the purposes of assessing the carbon footprint of a biomass-based alternative fuel, the transport of the fuel needs to be considered as it would for any primary or alternative fuel. The following assumptions were made:

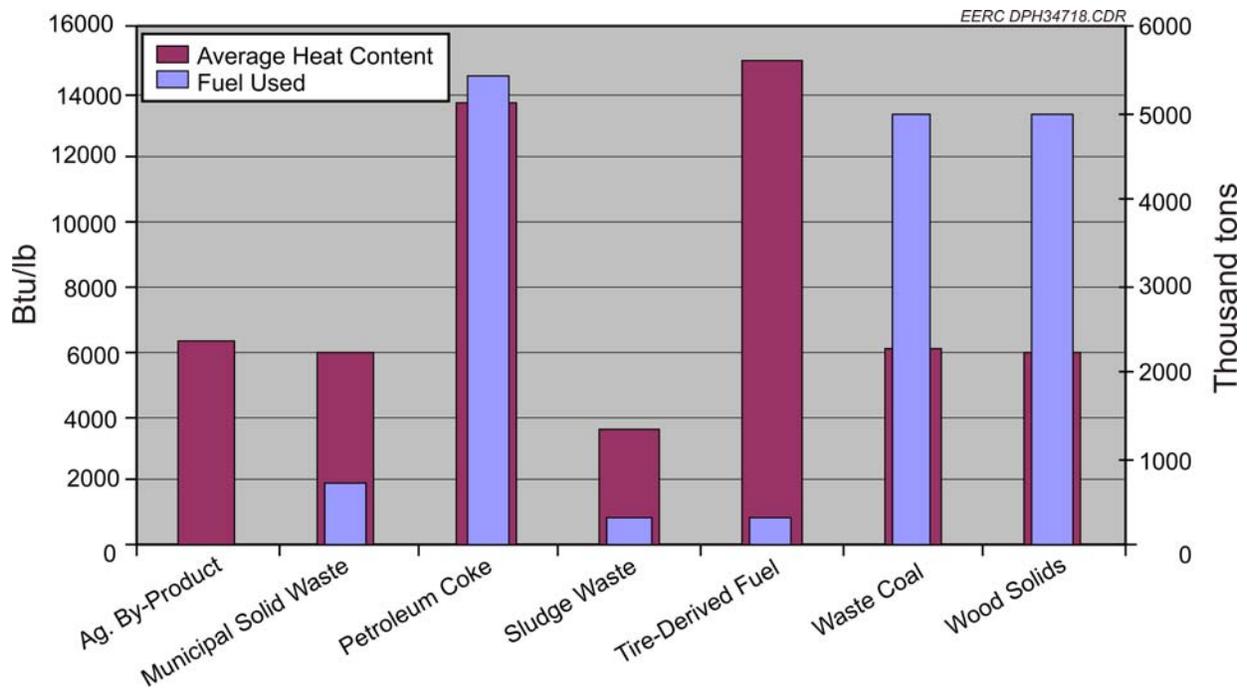


Figure 4. 2004 fuel used and average heat content.

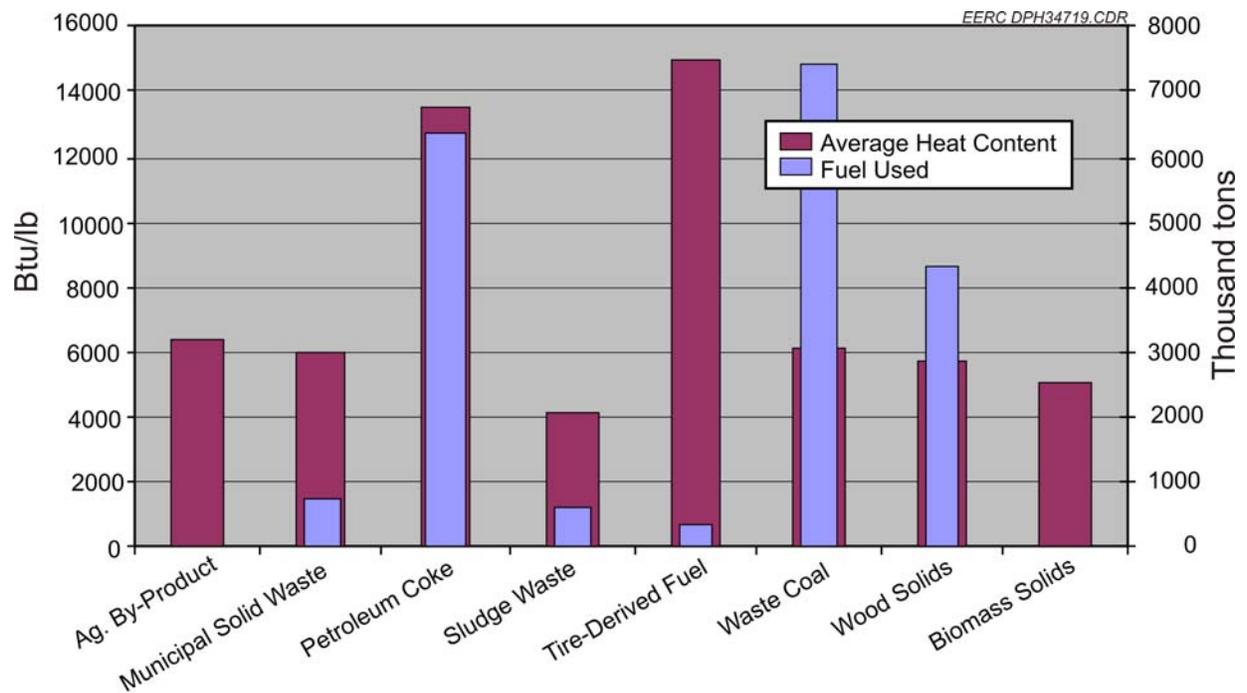
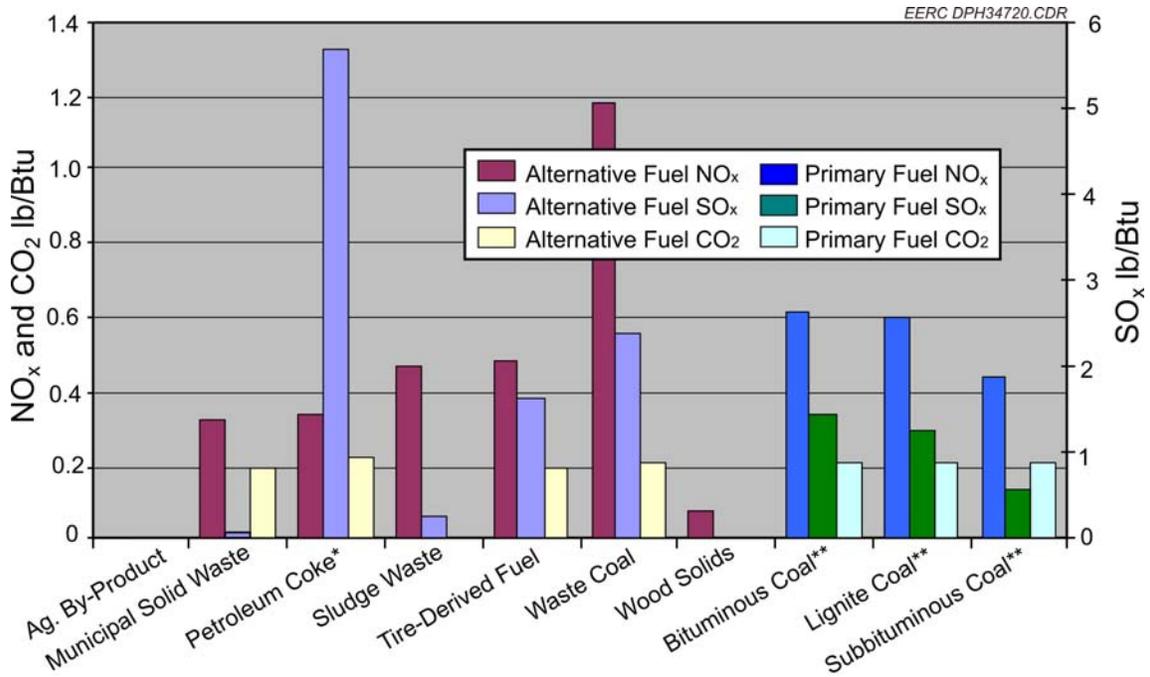
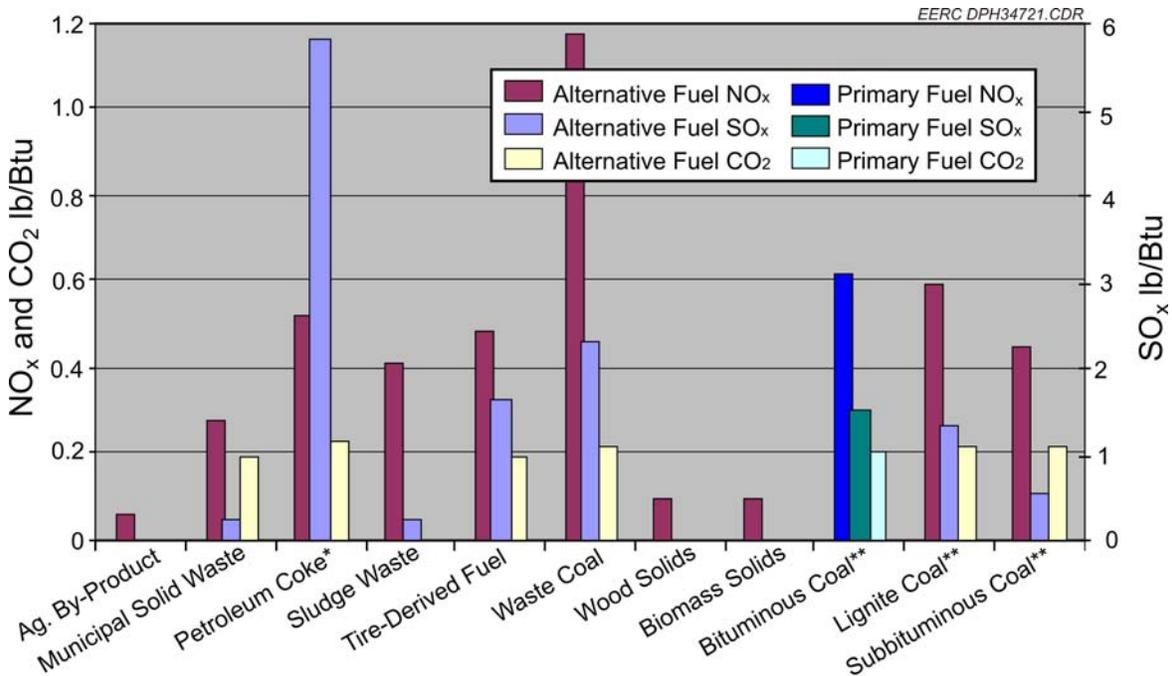


Figure 5. 2005 fuel used and average heat content.



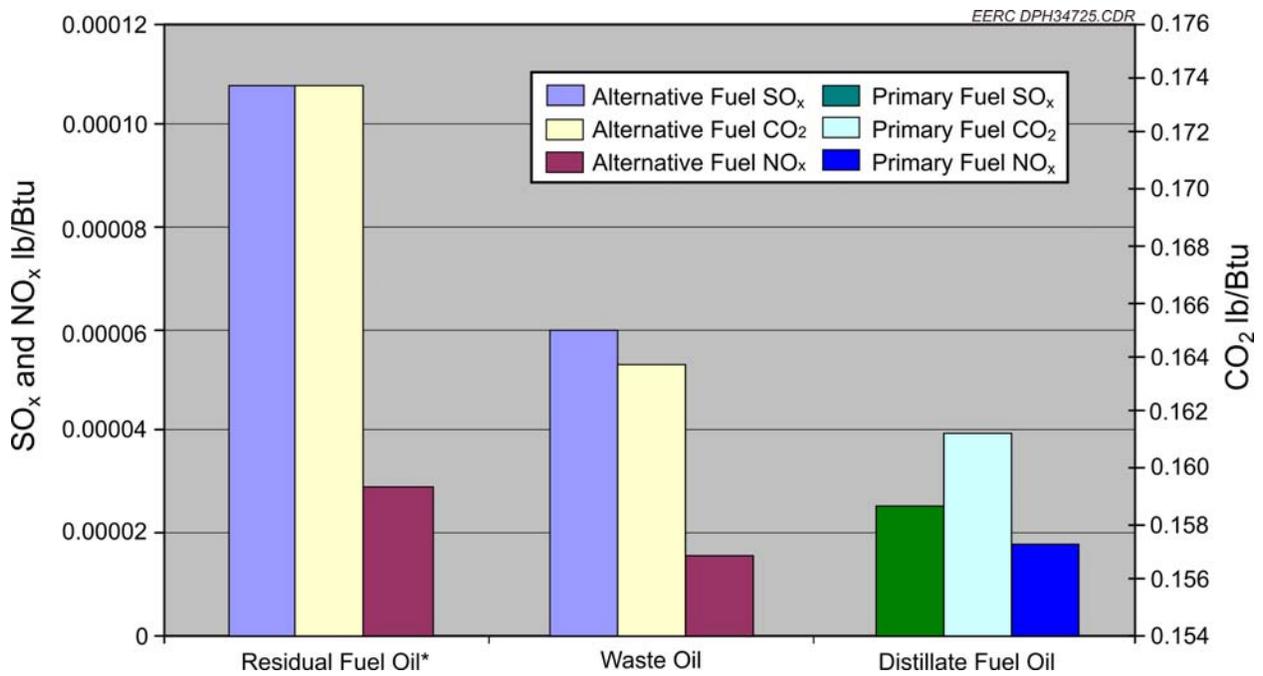
* 6% sulfur content used.
 ** Sulfur and nitrogen emissions calculated using weighted averages based on boiler types.

Figure 6. 2004 solid fuel SO_x, NO_x, and CO₂ emissions.



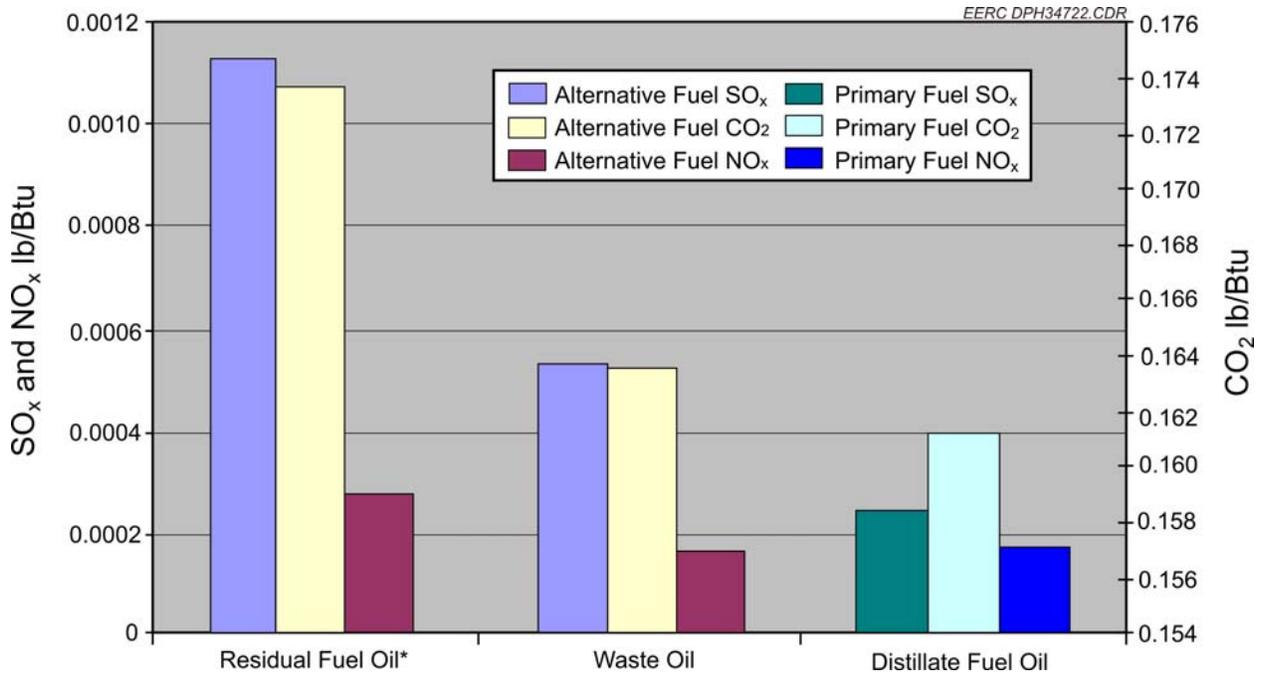
* 6% sulfur content used.
 ** Sulfur and nitrogen emissions calculated using weighted averages based on boiler types.

Figure 7. 2005 solid fuel SO_x, NO_x, and CO₂ emissions.



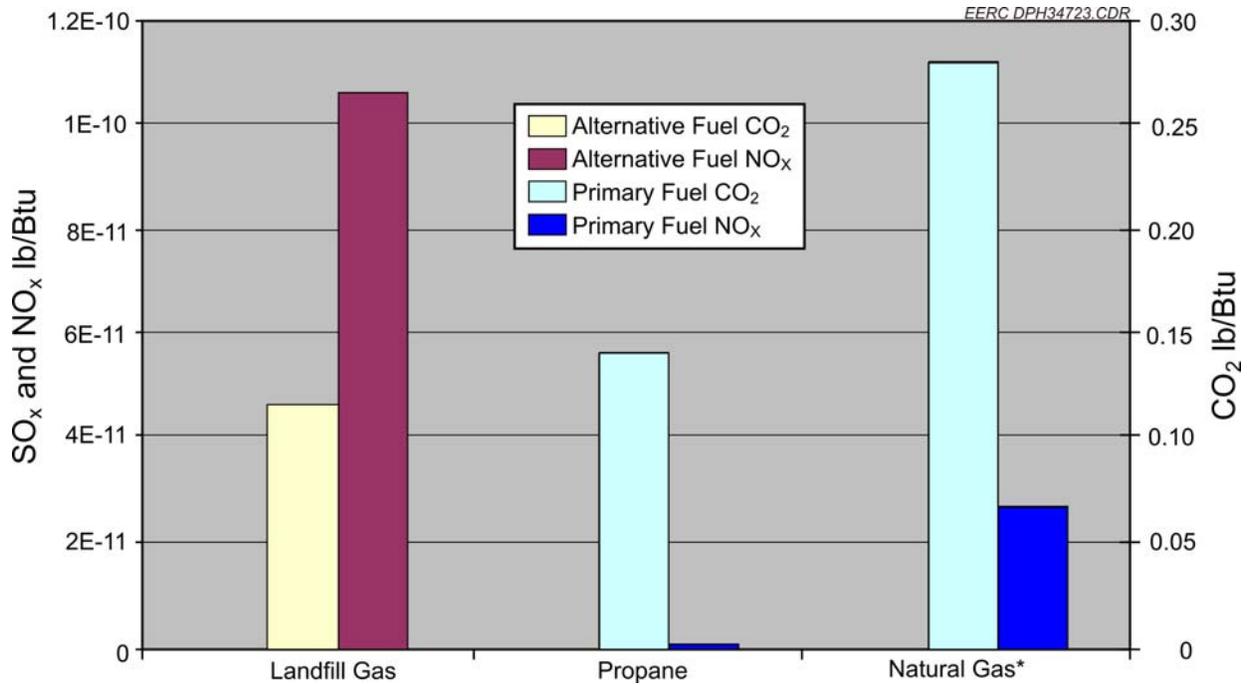
* Nitrogen emissions calculated using weighted averages based on boiler types.

Figure 8. 2004 liquid fuel SO_x, NO_x, and CO₂ emissions.



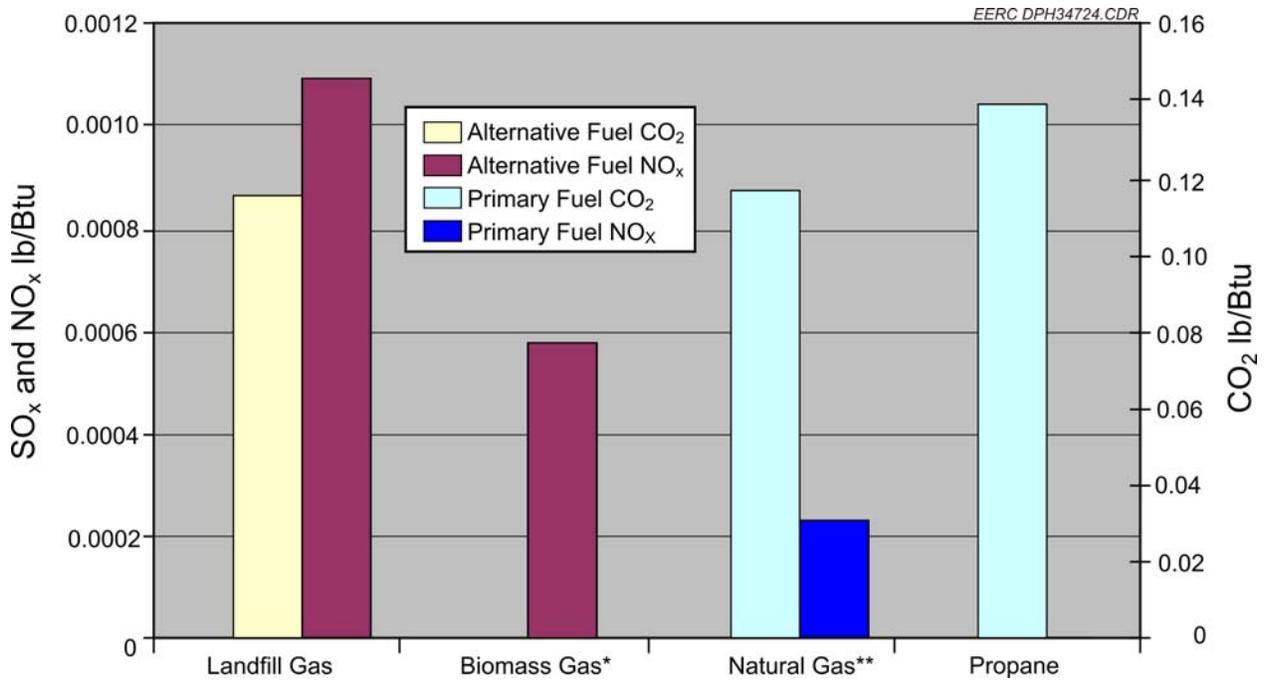
* Nitrogen emissions calculated using weighted averages based on boiler types.

Figure 9. 2005 liquid fuel SO_x, NO_x, and CO₂ emissions.



* Nitrogen emissions calculated using weighted averages based on boiler types.

Figure 10. 2004 gas fuel SO_x, NO_x, and CO₂ emissions.



* Emissions calculated using an average composition of 60% methane and 40% CO₂.

** Nitrogen emissions calculated using weighted averages based on boiler types.

Figure 11. 2005 gas fuel SO_x, NO_x, and CO₂ emissions.

- Wood waste would be utilized by a 80-MW power plant using subbituminous coal as its primary fuel; wood waste would be used at an 8% level by weight (14,100 tons) throughout the year.
- A typical transport distance would be 50 miles (round trip 100 miles).
- Wood waste would be in a delivery-ready state from the primary use process.
- Transport would be accomplished using over-the-road trucks with a capacity of 24 yd³ and a fuel efficiency of 6 mpg, and the CO₂ emissions from the use of diesel transportation fuel are 22 lb CO₂/gallon (8) of fuel used.
- Wood waste would have a unit weight of 48 lb/ft³ or 1296 lb/yd³ based on an average of unit weights for fresh green wood. (9).

The calculations used to determine the carbon dioxide emissions associated with the transport of wood waste for use by a coal-based electric generating facility on an annual basis are the following:

- 14,100 tons wood waste = 28,200,000 lb wood waste
- 28,200,000 lb wood waste/1296 lb/yd³ = 21,760 yd³ wood waste
- 21,760 yd³ wood waste/24 yd³ truck capacity = 907 truck loads
- 907 truck loads × 2 trips/truck × 50 miles/trip = 90,667 miles
- 90,667/6 mpg = 15,111.17 gal diesel fuel used
- 15,111.17 gal diesel fuel used × 22.2 lb CO₂/gal diesel fuel (8) = 335,568 lb CO₂ emitted for transportation of wood waste fuel annually

Based on the assumptions noted and the calculations shown, approximately 336,000 lb of CO₂ are emitted annually for wood waste transported 50 miles for use as an alternative fuel at an 80-MW plant utilizing 8% wood waste. Considering that many other primary and alternative fuels are transported significantly further than 50 miles, the carbon footprint of wood waste and potentially other biomass-based alternative fuels is expected to be lower than those transported further by truck. Transportation by rail has a lower CO₂ emission rate associated with that transportation because of better fuel efficiency.

Activity 3 – Determination of Regulatory Impacts to Alternative Fuel Usage

A review of emission regulations under CAA Section 112 for electric generating units and 129 for waste incinerators was performed (2, 1). Table 4 provides a summary of the emission limits for solid waste incinerators (10).

EPA estimated that CAA Section 129 (1) would decrease the total pollutant emissions from solid waste incinerator units by 2200 tons per year through the establishment of emission limits for these nine air pollutants: cadmium, mercury, lead, hydrogen chloride, dioxins/furans, carbon monoxide, nitrogen oxides, particulate matter, and sulfur dioxide (4). The emission limits

Table 4. Emission Limits for New and Existing OSWI^a Units

Pollutant	Emission Limits ^b
Cd	18 µg/dscm
CO	40 ppm _{dv}
Dioxins/Furans (total mass basis)	33 ng/dscm
HCl	15 ppm _{dv}
Pb	226 µg/dscm
Hg	74 µg/dscm
Opacity	10%
NO _x	103 ppm _{dv}
PM	0.013 gr/dscf
SO ₂	3.1 ppm _{dv}

^a Other solid waste incineration.

^b All emission limits (except opacity) are measured at 7% oxygen, dry basis at standard conditions.

in the rules were based on levels that can be achieved by installing wet scrubbers. Other emission control technologies could also be used, as long as they meet the required emission limits. The air pollutants that electric generating units are not required to meet under CAA Section 112 (2) are primarily cadmium, mercury, and lead, although regulation of mercury emissions is currently being addressed by coal-based electric generators. Most coal-based electric generating units do not employ wet scrubbers, although additional wet scrubbing systems are being installed to meet more stringent sulfur emission limits. Increased emission controls would be expected to be required if coal-based electric generating facilities using alternative fuels would be recategorized under CAA Section 129 (1) for solid waste incinerators, and if this change were made, it is anticipated that coal-fired electric generating facilities might reconsider the use of alternative fuels. In some cases, this would require disposal of these unused alternative fuels.

Activity 4 – Quarterly and Final Reports

Reporting included quarterly reports and a final report. Additionally, preliminary information collected in this task was presented in a poster presentation at the EUEC Energy & Environment Conference and Exposition February 2–4, 2009, in Phoenix, Arizona.

CONCLUSIONS

Based on the information assembled, the following conclusions were drawn:

- Alternative fuels are used broadly by coal-based electric generating facilities across the United States.
- Data imply that many alternative fuels are “opportunity fuels” and used based more on availability than on economic or environmental factors.

- Solid alternative fuels, with the exceptions of petroleum coke and waste coal, result in reduced sulfur dioxide, nitrogen oxide, and carbon dioxide emissions on a Btu basis as compared to coal.
- Biomass-based alternative fuels are considered carbon neutral but also are expected to have a smaller carbon footprint related to transport compared to other primary and alternative fuels.
- Changes in CAA emission regulation for coal-based electric generating facilities from Section 112 to Section 129 (2, 1) for solid waste incinerators should take into account the advantages of reduced emissions when alternative fuels are used to replace a percentage of fuel at coal-based electric generating units.

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APPENDIX A

**INFORMATION ON LIQUID AND GASEOUS
FUELS**

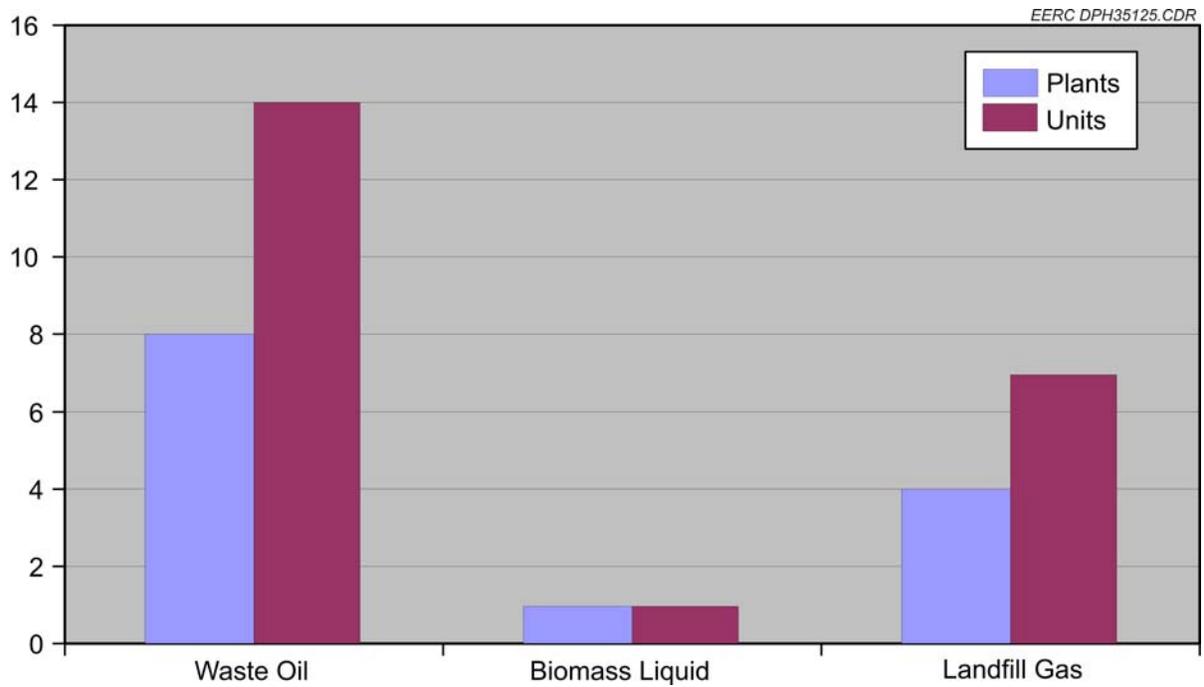


Figure A-1. 2004 plants and units using liquid and gas alternative fuels.

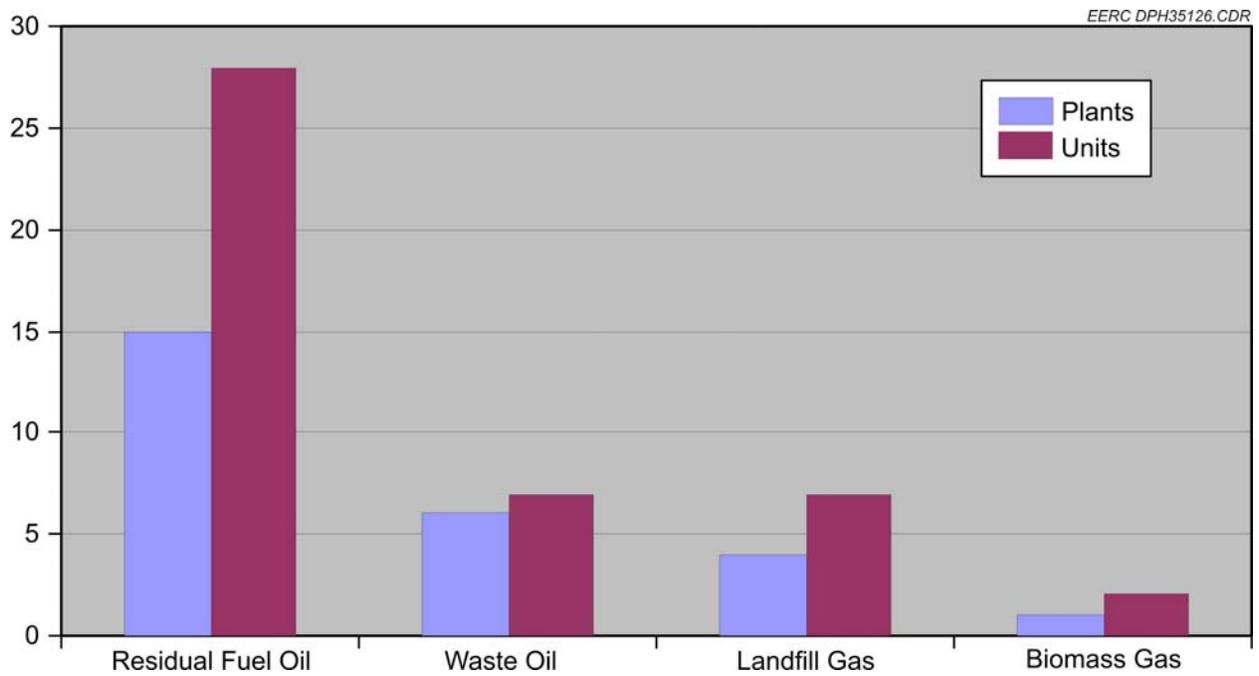


Figure A-2. 2005 plants and units using liquid and gas alternative fuels.

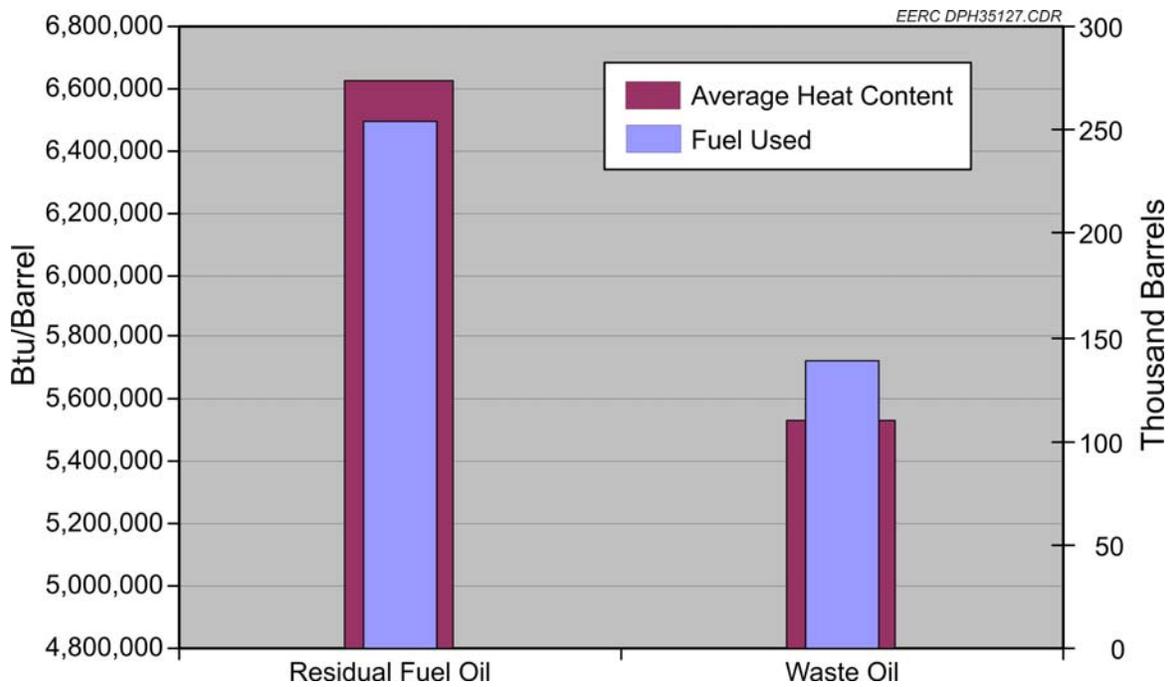


Figure A-3. 2004 quantity used and average heat content for liquid alternative fuels.

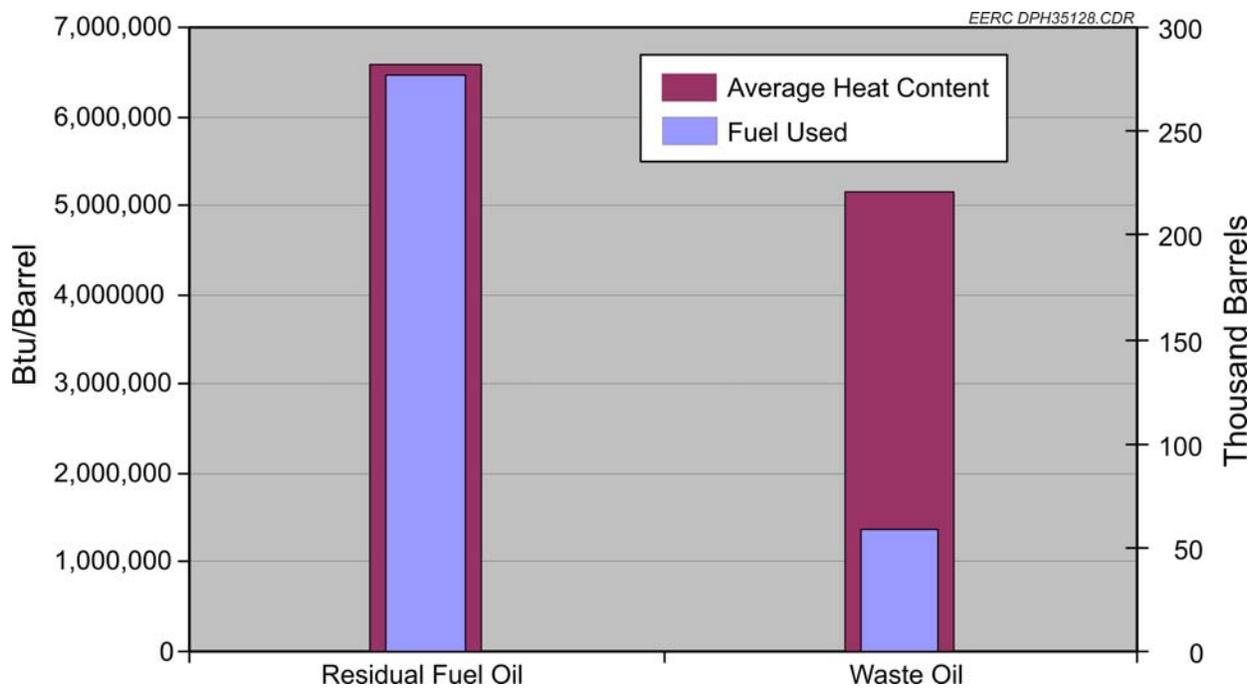


Figure A-4. 2005 quantity used and average heat content for liquid alternative fuels.

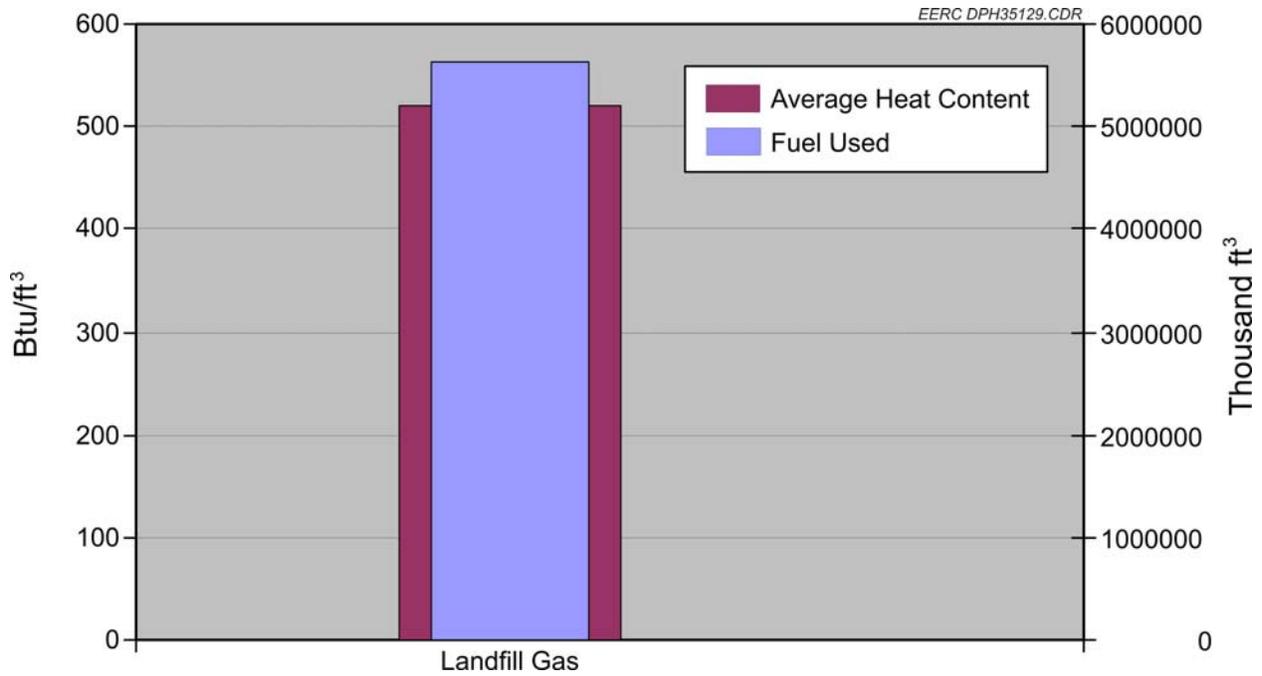


Figure A-5. 2004 quantity used and average heat content for gas alternative fuels.

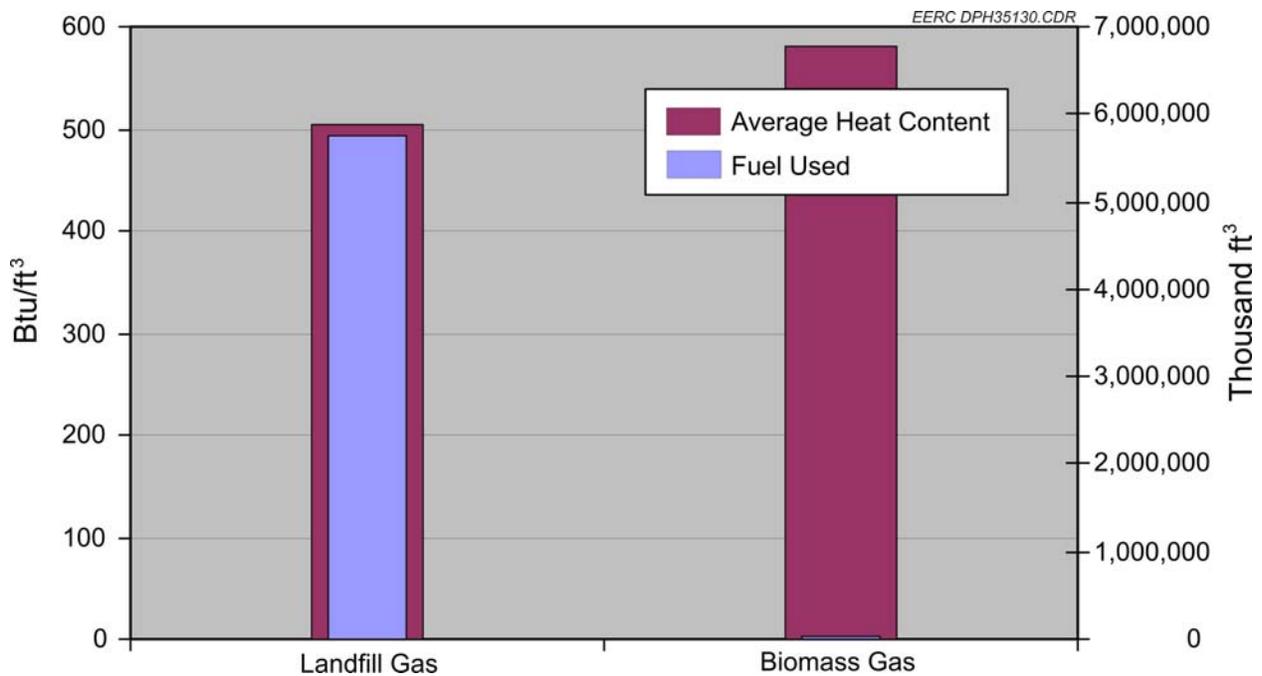


Figure A-6. 2005 quantity used and average heat content for gas alternative fuels.