Characterization and Analysis of Small Business Energy Costs

by

Andy Bollman
E.H. Pechan & Associates, Inc.
Durham, NC 27707

for

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When viewed at the macroeconomic level, even substantial energy price increases may not entail significant firm-level impacts because energy costs are a relatively small proportion of total overall production costs. However, energy expenditures are a much higher percentage of total input costs in certain industry sectors, and small entities often face unique challenges that affect their ability to absorb price increases.

To add to the state of knowledge on small entity impacts of energy price increases, this report compiles available information to (1) characterize the potential impact of energy price increases on small entities in individual industry sectors; and (2) identify whether, and to what extent, small entities face higher energy prices by major economic sector. The study results indicate that small entities in the manufacturing and commercial sectors have the greatest exposure to energy price rises.

Overall Findings

An analysis of sector-level energy price information indicates that small entities in the manufacturing and construction sectors pay higher prices for most, but not all, fuels. These price disparities are most pronounced for electricity and natural gas, with electricity in the manufacturing sector responsible for the greatest price differential. The smallest size establishment category (under 50 employees) pays 35 percent more for electricity than the sector average, while the largest establishment category (1,000 or more employees) pays 17 percent less than the sector average. Therefore, small manufacturing sector entities that use substantial amounts of electricity face a significant competitive disadvantage.

Highlights

The analysis found significant price differentials between what the smallest and largest entities paid for energy in the commercial and manufacturing sectors. Small businesses in the commercial sector faced a 30 percent price differential for electricity and a 20 percent price differential for natural gas. In the manufacturing sector, small businesses faced a 28 percent price differential for distillate fuel oil, a 27 percent price differential for natural gas, and a 14 percent price differential for coal.

Discussion

Of the 17 manufacturing sector industries for which 2002 data were available, small entities in 10 of these sectors spent considerably more on energy than larger entities when measured on the basis of expenditures per value of industry shipments. Three manufacturing sector industries had energy costs per dollar of output that were more than double those incurred by larger entities (food manufacturing; leather and allied products manufacturing; and computer and electronic product manufacturing). Profitability data further illustrate the challenges that small entities face from price increases in energy and other production inputs—13 of the 19 manufacturing sector industries with available profit data have profit margins that are lower for small entities than their larger counterparts.

Similarly, small entities have higher energy expenditures per dollar of sales than larger entities in 26 of the 31 commercial sector industries studied. The median commercial sector industry has a small entity energy cost per sales ratio that is 2.7 times the ratio

of large entities. General merchandise stores; food and beverage stores; and couriers and messengers are three of the commercial sector industries with the highest small entity energy cost per sales ratios relative to those of their larger counterparts. The couriers and messengers industry is particularly affected; its small entity energy expenditures add up to more than 10 percent of total small entity sales. As with manufacturing industries, a majority of commercial sector industries have lower small entity baseline profit margins than their larger industry counterparts.

Although the results for other economic sectors (agriculture, mining, construction, electric generation) show a more equal distribution of small and large entity baseline profit margins and energy expenditures per unit of output, all but the electric generation sector has one or more individual industries for which available data suggest that energy price increases are expected to result in greater impacts on small entities than large entities.[1]

This study highlights some of the unique challenges that confront small entities when energy prices rise, and identifies the economic sectors and specific industries in which small entities are most vulnerable to such price increases. Given continuing energy price trends, it is reasonable to assume that more and more small firms will see their competitive positions weakened, leading to impacts on capital availability and profitability, and the potential for small business closures.

Scope and Methodology

The researchers used publicly available data on energy costs from the Economic Census conducted by the U.S. Bureau of the Census in the Department of Commerce, the Department of Energy's Energy Information Administration (EIA), and the U.S. Department of Agriculture. All surveys measured expenditures by firms of various sizes on an array of energy goods, including fuels and electricity. The EIA surveys included considerably greater detail, but only covered the manufacturing, commercial, and electricity generation industries. Further data on firm size and revenues were taken from the Economic Census of 2002. Firm size, revenue, and energy use data were synthesized into industry tables and firms were compared across size categories to ascertain whether small firms pay proportionately more or less than their larger counterparts within an industry.

This report was peer reviewed consistent with the Office of Advocacy's data quality guidelines. More information on this process can be obtained by contacting the director of economic research at *advocacy@sba.gov* or (202) 205-6533.

Ordering Information

The full text of this report and summaries of other studies performed under contract with the U.S. Small Business Administration's Office of Advocacy are available on the Internet at ***www.sba.gov/advo/research***. Copies are available for purchase from:

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1 Data do not suggest that small entities in the Electric Generation sector face disproportionate energy price impacts—the likely cause for this phenomenon is the relative lack of competition in this sector (e.g., most jurisdictions grant monopolies to electricity providers, with retail electricity rates generally requiring the approval of the local public service commission).

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A. EXECUTIVE SUMMARY

When viewed at the macroeconomic level, even substantial energy price increases may not imply significant firm-level impacts because energy costs are a relatively small proportion of total overall production costs. However, energy expenditures are a much higher percentage of total input costs for many industry sectors, and small entities often face unique challenges that affect their ability to absorb price increases. This study provides information for understanding the significance of energy costs to small entities in individual industry sectors, and by extension, the potential for energy price increases to negatively impact these entities.

A literature review indicated a general lack of information characterizing the significance of energy prices to small entities; however, the limited information available suggests that rising energy prices and/or price uncertainty have more significant effects on smaller size firms. In addition, industry surveys of small entities in the manufacturing and construction sectors indicate that energy price increases are of growing concern to small businesses, and moreover, past price increases have had an impact on the earnings and profitability of a significant proportion of survey respondents.

To add to the state of knowledge on the impacts of energy price increases on small entities, the author compiled available information to (1) characterize each industry's potential for energy price increases to impact small entities and (2) identify whether, and to what extent, small entities face higher energy prices by major economic sector. The results indicate that the manufacturing and commercial sectors have the greatest potential for small entity energy price impacts. Of the 17 manufacturing sector industries for which 2002 data were available, small entities in 10 industries spent considerably more on energy than larger entities when measured on the basis of expenditures per value of industry shipments. In three manufacturing sector industries, the energy costs per dollar of output for small firms were more than double those incurred by larger entities (food manufacturing; leather and allied products manufacturing; and computer and electronic product manufacturing). Profitability data further illustrate the challenges that small entities face from energy (and other production input) price increases: 13 of

the 19 manufacturing sector industries with available profit data have lower profit margins among small entities than among their larger counterparts.

Similarly, small entities have higher energy expenditures per dollar of sales than larger entities for 26 of the 31 commercial sector industries studied. The median commercial sector industry has a small entity energy cost per sales ratio that is 2.7 times the ratio for large entities. General merchandise stores; food and beverage stores; and couriers and messengers are three of the commercial sector industries with the highest small entity energy cost per sales ratios relative to those of their larger counterparts. The couriers and messengers industry is particularly noteworthy in that small entity energy costs are more than 10 percent of the value of total small entity sales. As with manufacturing industries, a majority of commercial sector industries have lower small entity baseline profit margins than their larger counterparts.

Although the results for other economic sectors (agriculture, mining, construction, electric generation) show a more even distribution of small and large entity baseline profit margins and energy expenditures per unit of output, all but the electric generation sector have one or more individual industries for which available data suggest that energy price increases are expected to result in greater impacts on small entities than large entities.[1]

An analysis of sector-level energy price information indicates that small entities in the manufacturing and construction sectors pay higher prices for most, but not all, fuels. These price disparities are most pronounced for electricity and natural gas, with electricity in the manufacturing sector responsible for the greatest price differential; the smallest size establishment category (under 50 employees) pays 35 percent more than the sector average for electricity, while the largest category (1,000 or more employees) pays 17 percent less than the sector average. Therefore, small manufacturing entities that use substantial amounts of electricity face a significant competitive disadvantage. In addition, significant price differentials between smallest and largest entities were found in these sectors:

[1] Data do not suggest that small entities in the electric generation sector face disproportionate energy price impacts. The likely cause of this phenomenon is the relative lack of competition in this sector (e.g., most jurisdictions grant monopolies to electricity providers, with retail electricity rates generally requiring the approval of the local public service commission).

- 30 percent price differential for electricity used in the commercial sector;
- 28 percent price differential for distillate fuel oil used in the manufacturing sector;
- 27 percent price differential for natural gas used in the manufacturing sector;
- 20 percent price differential for natural gas used in the commercial sector; and
- 14 percent price differential for coal used in the manufacturing sector.

This study highlights some of the unique challenges that confront small entities when energy prices rise, and it identifies the economic sectors and specific industries in which small entities are most vulnerable to such price increases. Given continuing energy price trends, it is reasonable to assume that a growing number of small firms will see their competitive positions weakened, with ramifications for their ability to raise capital and their profitability, as well as the potential for small business closures.

B. INTRODUCTION

The purpose of this study was to compile available energy data from federal government and other sources to characterize the impact of energy costs by industry sector, firm size, and fuel type.[2] This study provides key information for understanding the potential for energy cost increases to negatively affect small entities by industry sector.

When firms are forced to absorb energy price increases, profit margins will be reduced or potentially eliminated. Given the prevalence of economic globalization, increased energy costs in the United States can result in domestic plant closures in cases where firms are no longer able to compete with foreign plants with lower cost structures. More generally, reduced profits may result in cash flow impacts, which may affect firms' access to capital for investments, a particular concern for small firms, which tend to have greater difficulty raising capital than larger firms. Furthermore, energy cost increases will result in reduced product demand and reduced revenues to the extent that such costs are passed through to consumers.[3] For sectors that use energy both as a fuel and raw material (e.g., plastics), the impact of energy price increases can be compounded.

When viewed at a broad level, energy costs are a relatively small proportion of total intermediate production inputs. Even fairly large energy price increases may not suggest a significant effect when viewed at this aggregate level. However, energy expenditures are a much higher percentage of total input costs for certain industry sectors.

To assist in understanding the issue, the author performed a review of the literature on small firm energy costs and energy price increase impacts. Much of the literature either dates to the energy crises of the 1970s/early 1980s, or is not specific to small businesses. Many of the most recent studies rely on data that predates energy price shocks that followed in the aftermath of the Gulf Coast hurricanes of 2005. There were two different types of relevant studies identified via the

[2] The author also sought to characterize energy costs by geographic region, but the available data were deemed too limited to allow such characterization.

[3] Additional reductions in demand will occur via energy price increases at the consumer level (e.g., gasoline and residential heating and cooling costs), which strain household energy budgets.

literature review: (1) quantitative analysis papers from the academic literature; and (2) reports summarizing the results of surveys conducted by industry trade associations. While the first group presents theoretical analyses of energy cost-related concepts (e.g., uncertainty, variable input costs, and returns to scale) on small firm decision-making, the second group uses survey data to draw conclusions about the impact of increased energy prices on small businesses. A synthesis of these different studies leads towards the general conclusion that, all else being equal, energy price increases and price uncertainty are of greater concern to small businesses than large businesses.

1. Review of Academic Literature

Given the paucity of small business energy price impact literature, the focus of the review of academic literature is necessarily limited to the impact of price increases for general production inputs. It is reasonable to assume, however, that the results from these studies can be applied to energy inputs. The following three studies suggest that energy price increases, as well as increased energy price uncertainty, have larger impacts on smaller size firms.

Nguyen and Lee (2002)

Nguyen and Lee recently assessed the potential disparity in economies of scale between U.S. manufacturing companies of different sizes. Using 1991 data from the Manufacturing Energy Consumption Survey (MECS) and the Annual Survey of Manufacturers, Nguyen and Lee found that there is no statistically significant difference in production efficiency between establishments of different sizes—that is, small establishments were determined to produce as much output for a given level of inputs as large establishments (Nguyen and Lee, 2002). Output in this study was measured as value of shipments, and capital, labor, materials, and energy were the inputs included in the establishment size production functions.

The study's applicability to the issue at hand is limited in that: (1) data constraints restricted the analysis to establishments with at least 20 employees; (2) it did not investigate the potential for industry-specific economy of scale differences existing within the Manufacturing sector; and (3)

it solely focused on the manufacturing sector (while the majority of small firms are found in other industry sectors).

In addition, the study does not state whether the analysis incorporated establishment size energy price differentials that appear to exist.[4] If large and small manufacturers pay similar prices for energy (and/or face similar energy price increases), then the study suggests that increased energy prices do not differentially impact small manufacturers' ability to competitively produce goods because they are no less efficient in converting inputs (of which energy is one) into production. Given their similar estimated production efficiencies, however, any production input price disadvantages that smaller manufacturers may experience (including energy costs), would be expected to place them at a competitive disadvantage relative to their larger counterparts. [Section D.2 of this report describes data indicating that small manufacturing sector entities pay substantially higher prices for electricity, natural gas, and distillate fuel oil than large entities.]

Ghosal and Loungani (2000)

Uncertainty about the price of production inputs such as energy can cause firms to become more averse to risking investments in capital. Ghosal and Loungani establish a negative investment-uncertainty relationship among manufacturing firms in the United States (Ghosal and Loungani, 2000), and the ratio is greater for smaller firms. Therefore, increases in the uncertainty of energy cost inputs are expected to result in less overall capital investment by businesses, with smaller firms experiencing greater reductions.

Koetse, *et al.*, 2006

In a study that yielded a similar result to that of Ghosal and Loungani (2000), Koetse *et al*. (2006) further identifies the impact of energy price uncertainty on capital investment. In this case, the authors studied the impact of perceived wage and energy price uncertainty on capital

[4] In particular, the paper only describes how energy quantity estimates were developed by establishment size—no information is provided on how quantities were converted to expenditures (i.e., whether an overall average fuel price was applied or whether the existence of establishment size category-specific prices was investigated/incorporated).

investment and investment in energy-saving technologies. They find that "especially for investment in energy-saving technologies, there is strong evidence of structural differences between small and large firms. Specifically, uncertainty appears to have a larger influence on decision making in small firms than in large firms" (Koetse *et al.*, 2006). They cite the ability of larger firms to hedge against risk and absorb investments with longer payback periods as key reasons for the disparity in the investment-uncertainty ratio between small and large firms.

These studies suggest likely capital investment impacts from the large energy price fluctuations experienced recently, including impacts on investments in energy efficiency improvements. They further indicate that such impacts are likely to be more pronounced for smaller firms.

2. Review of Industry Literature

The four reports discussed below provide the results of targeted surveys to identify issues of greatest concern to small firms. The reports generally focus on small firms in a specific sector (either construction or manufacturing). The surveys indicate that rising energy prices are of increasing concern to small businesses and that past increases have led to earnings and profitability impacts for a significant share of respondents.

Associated General Contractors of America

A November 2005 Associated General Contractors (AGC) report focuses on construction sector costs, including energy costs (AGC, 2005). The report notes that diesel fuel cost increases affect the construction sector in multiple ways since diesel fuel is used to operate off-road equipment (e.g., earthmovers and tower cranes), to run motors for construction vehicles (e.g., concrete mixers, pumpers, and dump trucks), and as fuel for transporting construction material deliveries and construction debris. The report finds that diesel fuel prices paid by U.S. construction firms rose by an average of 47 cents per gallon, or 22 percent between 2004 and 2005.

The report also notes that natural gas prices directly affect the cost of a variety of construction plastics that use natural gas as a feedstock, pointing to a recent increase in the price for polyvinyl

chloride (PVC) pipe of 20 to 100 percent. Given supply interruptions from the 2005 Gulf Coast hurricanes, coupled with an explosion at a key plastics factory in Texas and the potential for weather-related demand increases for natural gas, AGC indicated that other hydrocarbon-based products such as insulation, roofing materials, and membranes will likely see a near-term price of increase of 20 to 50 percent.

The report does not delve into how construction businesses are coping with increased diesel fuel and natural gas costs (nor price uncertainty for other key inputs such as cement and concrete, steel, gypsum, and wood products).

International Profit Associates' Small Business Research Board

Early in 2006, the International Profit Associates' Small Business Research Board performed a survey of small businesses, with particular emphasis on the construction industry. The survey asked respondents what the single most important issue was for their small businesses. Twenty-five percent of Construction industry respondents cited the cost of materials as the most important issue; 10 percent of respondents in non-construction businesses cited these costs as most important. Only 3 percent of small construction businesses cited energy and fuel costs as the most important issue, while 16 percent of small non-construction businesses identified these costs as most important.

In a survey conducted in the second quarter of 2007, small businesses across all surveyed industries listed energy and fuel costs as the third most important issue of concern, while small Construction and Contracting industry firms listed these costs as the second most important issue (IPA, 2007).[5] Although not directly comparable, the results of these two surveys suggest a shift in attention to energy costs.

[5] Taxes were considered to be the most important issue by both groups of small business owners.

National Federation of Independent Businesses

In 2001, the National Federation of Independent Businesses (NFIB) conducted a poll of approximately 750 small businesses to determine how these firms adjust to price (including energy price) increases (NFIB, 2006). The survey results indicated the following with respect to actions taken in response to energy price increases in the first half of 2001:

- Three types of energy – gasoline, electricity, and natural gas – were responsible for nearly all concerns about energy prices, with most respondents identifying gasoline price increases as impacting their small businesses;
- The most prevalent way of offsetting increasing energy costs was reducing earnings; 76 percent of small business owners reported adjustment via lower earnings or profits; the second most frequently taken way of adjusting was energy conservation measures (57 percent); only 29 percent of owners indicated implementing price increases;
- Actions taken to adjust for cost increases were heavily influenced by the size of the increase and the amount of advance notice the owner had that a price increase was forthcoming; and
- About one quarter of respondents indicated that it is likely or highly likely that cost increases with no notice will force them to borrow to ease the adjustment to the price increase.

One shortcoming acknowledged by NFIB researchers was that the survey data did not indicate levels of baseline profitability. Therefore, they were unable to determine whether particular responses were more likely based on firm financial health.

National Association of Manufacturers

In a 2001 report, the National Association of Manufacturers (NAM) notes that small and medium-size manufacturers consumed about 38 percent of all energy used in manufacturing, but paid approximately 52 percent of the total cost of manufacturing energy (NAM, 2001).[6] These data suggest that smaller manufacturing firms face considerably higher energy prices than larger firms. The report also notes that the energy costs of small- and medium-sized manufacturers increased by $115 billion in 1999, or 1 percent of total U.S. gross domestic product.

A survey of NAM members indicated that a 58 percent increase in natural gas prices between 1999 and 2000 reduced profits by an average of 13 percent. However, some companies saw profits reduced by as much as 150 percent. More than half of the businesses surveyed asserted that an investment tax credit would provide a sufficient incentive for them to upgrade to more energy efficient boilers, the piece of equipment responsible for the greatest energy use in manufacturing plants.

C. SUMMARY OF STUDY METHODS AND DATA SOURCES

The author compiled energy data from federal government and other sources to characterize the impact of energy costs by industry sector, entity size, and fuel type.[7] Table 1 displays a summary of the energy expenditure data developed by major sector, including the level of industry sector detail and specific fuel types for which costs were developed. This table highlights the data limitations that constrain the ability to develop consistent expenditure data across all sectors.

[6] For this study, NAM defined small manufacturers as firms that employ 500 or fewer employees, and medium manufacturers as those employing between 500 and 2,000 employees.

[7] The data analysis may assist future researchers in understanding how energy cost increases affect small entities in specific industries; and it may help identify key industry sectors for focusing a survey to understand the actions that they have taken to address past energy price increases, and the challenges associated with potential future price increases.

Table 1. Summary of Small Entity Energy Expenditure Estimation

Sector	NAICS Code Level	Reflect Potential Price Differential Between Small and Large Entities?	Electricity/Fuel Types for which Estimates Developed	Comments
Agriculture	4-digit or 5-digit	Yes – by sales category: <$100k; $100k-$249,999; $250k-$499,999; $500k-$999,999; and $1+ million	Electricity; gasoline and gasohol; diesel fuel; natural gas; and "LP gas, fuel oil, kerosene, motor oil, grease, etc."	Energy expenditure data not available for NAICS codes: 1133 (logging); 1141 (fishing); 1142 (hunting and trapping); 1151 (support activities for crop production); 1152 (support activities for animal production); and 1153 (support activities for forestry)
Mining	3-digit	No	None, although data are available to estimate electricity expenditures	Assumes the same energy cost/total cost of supplies ratio for all size categories.
Construction	3-digit	No	Electricity; natural/manufactured gas; gasoline/diesel obtained from other establishments of company or purchased from other companies; purchased on-highway fuel; purchased off-highway fuel; and "all other fuels/lube" (above only available at NAICS code-level, not receipts size category-level)	Assumes the same energy cost/total cost of supplies ratio for all revenue size categories (and fuel type estimates assume same proportion of total energy cost from each fuel type for all size categories).
Electric Generation	NAICS 2211	Yes for all 223 public utilities and about one-third of private utility fuel records	10 fuel types, but only for private utilities	Estimates computed for each individual utility. Energy expenditure data not available for NAICS codes: 2212 (natural gas distribution) and 2213 (water sewage & other systems)
Manufacturing	3-digit	Yes – by employment size category: <50; 50-99; 100-249; 250-499; 500-999; and 1000+	Depends on NAICS code–may include: electricity; residual fuel oil; distillate fuel oil; natural gas; liquefied petroleum gas and natural gas liquids; coal; and coke & breeze.	Regional data were available in some, but not all, cases; only national data are reported.
Commercial	3-digit	Yes – by employment size category: <5; 5-9; 10-19; 20-49; 50-99; 100+	Electricity, natural gas, and fuel oil	No available information on commercial sector motor fuel expenditures. Energy expenditure data are not available for all commercial sector industries.

1. Energy Expenditure Data

Detailed economic information is available every five years from the Economic Census conducted by the U.S. Department of Commerce's Bureau of the Census. Economic Census publications provide useful information characterizing energy expenditures for most economic sectors (e.g., the 2002 Census publication Business Expenses Survey reports the total cost of materials, and the cost of electricity and fuels for many industry sectors). The last Economic Census was conducted for 2002 – a year that did not experience unusually high or low energy prices. Therefore, 2002 Economic Census data should be representative of long-run energy costs.

For three sectors, detailed energy data were available from the Department of Energy's Energy Information Administration (EIA):

- **Electric Generation** – 2002 data from Form EIA-861 ("Annual Electric Power Industry Report") database; Schedule 7 ("Electric Operation and Maintenance Costs") of Form EIA-412 ("Annual Electric Industry Financial Report") database; Form EIA-906 ("Power Plant Report) database; Form EIA-423 ("Monthly Cost and Quality of Fuels for Electric Plants Report") database; and the report *Cost and Quality of Fuels for Electric Plants, 2002 and 2003*;

- **Manufacturing** – 2002 Manufacturing Energy Consumption Survey (MECS); and

- **Commercial** – 2003 Commercial Buildings Energy Consumption Survey (CBECS).

In addition to the above EIA sources and the Economic Census publications, the author also compiled agriculture sector energy expenditure data from the U.S. Department of Agriculture (USDA)'s 2005, 2002, and 1997 Census of Agriculture and the USDA's Farm and Operator Households database.

To evaluate the relative impact of energy costs on small entities in these sectors, we used the above data sources to develop energy costs for specific establishment size categories.[8] Table 2 reports all of the size categories for which the author estimated energy expenditures, and the size categories that were aggregated to represent small entities in each major sector.
Appendix A provides further details on the data sources and procedures used to estimate energy expenditures by sector and size category.

2. Revenue Data

Guidance published by the U.S. Small Business Administration's Office of Advocacy suggests that costs as a percentage of total revenues is a metric for evaluating the burden of cost increases on small entities in relation to the burden for large entities (SBA, 2003). To facilitate calculation of energy cost-to-revenue percentages, the author compiled revenue data by size category that match the size categories for which energy expenditure data were developed. These revenue data were generally compiled from the appropriate sector publication of the 2002 Economic Census:

- Agriculture – 2002 Census of Agriculture;
- Mining – 2002 Census of Mining;
- Construction – 2002 Census of Construction; and
- Manufacturing – 2002 Census of Manufacturing.

[8] Because energy cost impacts are ultimately determined by firms rather than establishments, firm-level energy data were preferred. However, these data are not generally available.

Table 2. Energy Expenditure Estimate Size Categories

Sector	Unit of Measure	Size Categories	Small Size Category
Agriculture	Revenue per Farm	Less than $100,000 $100,000 to $249,999 $250,000 to $499,999 $500,000 to $999,999 $1 million or more	Farms with less than $500,000 in revenue
Mining	Employees per Establishment	0 to 4 5 to 9 10 to 19 20 to 49 50 to 99 100 to 249 250 to 499 500 to 999 1,000 to 2,499 2,500 or more	Establishments with less than 500 employees
Construction	Sales or Receipts per Establishment	Less than $25,000 $25,000 to $49,999 $50,000 to $99,999 $100,000 to $249,999 $250,000 to $499,999 $500,000 to $999,999 $1 million to $2,499,999 $2,500,000 to $4,999,999 $5 million to $9,999,999 $10 million or more	Establishments with sales or receipts less than $10 million
Electric Generation		Each individual utility	Utilities with net electric generation of 4 million megawatthours or less
Manufacturing	Employees per establishment	1 to 4 5 to 9 10 to 19 20 to 49 50 to 99 100 to 249 250 to 499 500 to 999 1,000 to 2,499 2,500 or more	Establishments with less than 500 employees
Commercial	Employees per establishment	1 to 4 5 to 9 10 to 19 20 to 49 50 to 99 100 or more	Establishments with less than 100 employees

For the commercial sector, revenue data were first compiled from Economic Census data available from the Bureau of the Census's AmericanFactFinder weblink.[9] In cases where revenue data were reported in the Bureau of Census's 2002 Business Expense Survey with different values than the Economic Census estimates, the author adjusted the Census values to match the Business Expense Survey. These adjustments were implemented to ensure consistency with the energy expenditure data compiled from the Business Expense Survey. (See Appendix A for details.) For the electric generation sector, the author compiled 2002 revenue data for each individual utility from EIA's *Annual Electricity Industry Financial Report*, based on the 2002 Form EIA-861 database.

3. Profit Data

The author compiled profitability data (pre-tax profits as a percentage of sales) by North American Industrial Classification System (NAICS) code and firm size from Risk Management Association's online version of *Annual Statement Studies* (RMA, 2007). These data assist in identifying sectors for which small entities' baseline profit margins are particularly slim, indicating the potential for relatively small energy price increases to negatively impact small firm health. Risk Management Association's firm size profitability data were available for the following sales ranges: $0 to $1 million; $1 million to $3 million; $3 million to $5 million; $5 million to $10 million; $10 million to $25 million; and more than $25 million. To develop NAICS code-level estimates of average profits as a percentage of sales for small and large firms, the author identified a representative small firm threshold for each major sector. Table 3 identifies this threshold, which was selected to most closely match SBA's small firm threshold.[10] Table 3 also repeats the small entity threshold used in compiling small establishment energy

[9] AmericanFactFinder, which is located at http://factfinder.census.gov/, is a repository for Economic Census data, including revenue data that appear in the following publications covering the commercial sector: wholesale trade; retail trade; transportation and warehousing; information; finance and insurance; real estate and rental and leasing; professional, scientific, and technical services; management of companies and enterprises; administrative and support and waste management and remediation services; educational services; health care and social assistance; arts, entertainment, and recreation; accommodation and food services; and other services (except public administration).

[10] The SBA designates small business size standards at the 6-digit NAICS code level. Because revenue and energy expenditure data by size category were generally not available at this level of detail, the author identified a major sector-level firm size threshold reflecting the predominant industry size standard within each sector.

expenditure data as reported in Table 2 above. To estimate average small and large firm profitability within each NAICS code, the author weighted the pre-tax profit margins for each of the appropriate firm size categories by the *Annual Statement Studies* reported sales data for each size category.

Table 3. Comparison of Small Size Category Definitions

Sector	Predominant SBA Small Firm Size Threshold	Energy Expenditure Data Small Size Category	Profitability Data Small Size Category	Rationale for Selection of Small Firm Profitability Sales Category
Agriculture	$750,000 in revenue	Farms with less than $500,000 in revenue	Firms with less than $1 million in sales	Smallest size category available
Mining	500 employees	Establishments with less than 500 employees	Firms with less than $10 million in sales	Overall mining sector average revenues of $5.7 million for *establishments* with 500 or less employees
Construction	$13 million in revenue	Establishments with sales or receipts less than $10 million	Firms with less than $10 million in sales	$10 million is closest available category to SBA small firm threshold
Electric Generation	Net electric generation of 4 million megawatthours	Utilities with net electric generation of 4 million megawatthours or less	(no profitability data available)	
Manufacturing	500 employees	Establishments with less than 500 employees	Firms with less than $25 million in sales	$25+ million is largest available size category ($92.0 million is average value of shipments for manufacturing sector *establishments* with 250-499 employees)
Commercial	100 employees	Establishments with less than 100 employees	Firms with less than $10 million in sales	Approximately $9.7 million in sales for commercial sector *establishments* with 50 to 99 employees

D. RESULTS

The following two sections present the results of the analyses performed in this study—the first section characterizes energy cost impacts by industry sector, entity size, and fuel type. This is followed by a section that identifies manufacturing, commercial, and electric generation sector energy price differentials by establishment size category and fuel type.

1. Energy Expenditure Impacts

Table 4 presents total estimated 2002 small entity energy expenditures by major sector. This table indicates that more than 85 percent of total small entity energy expenditures occurred in the commercial and manufacturing sectors.

Table 4. Summary of 2002 Small Entity Energy Expenditures by Major Sector

Major Sector	NAICS Codes	Estimated Small Entity Energy Expenditures ($million)	Share of Total Small Entity Energy Expenditures (percent)
Commercial	423 thru 813	52,343	41.0
Manufacturing	311 thru 339	45,629	35.7
Construction	236 thru 238	14,011	11.0
Agriculture	111 thru 112	7,876	6.2
Mining	211 thru 213	5,443	4.3
Electricity Generation	2211	2,482	1.9
SUBTOTAL		**127,784**	100

Tables 5 through 10 present the following information for each major sector NAICS code for which energy expenditure data were available:

- Total small entity energy expenditures (in millions of dollars);
- Small entity energy expenditures as a percentage of small entity revenue;[11]
- The ratio of small entity energy expenditures as a percentage of small entity revenue to large entity energy expenditures as a percentage of large entity revenue;
- Small entity pre-tax profit margin; and
- The ratio of the small entity pre-tax profit margin to the large entity pre-tax profit margin.

Measures 1 and 2 provide direct information for evaluating the significance of energy costs to small entities in each NAICS code; higher values indicating greater importance within that industry. Measure 3 evaluates whether energy costs are of greater significance to small entities than large entities within that NAICS codes; larger values suggest that energy costs disproportionately impact small entities in that sector (i.e., for a given dollar of revenue, small entities spent more on energy than large entities). Smaller values for measure 4 indicate that small entities have lower profit margins, indicating the potential for relatively small energy price increases to negatively impact small firm health. The final measure (ratio of the small entity pre-tax profit margin to the large entity pre-tax profit margin) shows whether small entity baseline profitability is higher or lower than that of large entities. Values below 1.0 suggest that smaller entities have less ability than larger entities to absorb energy price increases via reductions in profits.

Tables 11 through 13 identify the sectors in which energy costs are of greatest concern to small entities. Table 11 lists the ten sectors with the highest total small entity energy costs; Table 12 lists the ten sectors in which small entities have the highest ratios of energy expenditures to revenue; and Table 13 lists the ten sectors in which energy costs, measured as a percentage of sector revenue, are of greater significance to small entities than large entities.

[11] For the construction sector, percentages are relative to total value of business done; for the manufacturing sector, percentages are relative to value of shipments; for the commercial sector, percentages are relative to sales.

Table 14 identifies the five sectors in which small entities appear to be most vulnerable to energy price increases. These sectors were chosen because they appear the most often in Tables 11-13; they have low small entity profit margins; and the small entities in these sectors generally have lower profitability levels than the sector's large entities (suggesting that small entities in these sectors have a less ability to absorb energy price increases than large entities).

For the five sectors identified in Table 14, Table 15 reports the percentage of 2002 total small entity energy expenditures by type of energy.[12] This table clearly indicates that the importance of each energy type is varies by sector. For example, electricity accounted for more than 92 percent of 2002 small entity energy expenditures in the general merchandise stores sector, but only 3 percent of total energy expenditures in the truck transportation sector. Similarly, natural gas was responsible for more than one-quarter of the small entity energy expenditures in the durable goods merchant wholesalers sector, but less than 1 percent of total energy expenditures in the truck transportation sector. As expected, the two transportation-related priority sectors identified in Table 15 (truck transportation and couriers and messengers) have the greatest percentage of total expenditures from motor fuels (96 percent and 83 percent, respectively). Of the priority sectors, the dairy cattle and milk production sector is unique in that electricity and motor fuels are responsible for similar percentages of total energy expenditures.

[12] Because size category-specific motor fuel expenditure data were not available for the couriers and messengers and truck transportation sectors, Table 15 reports overall sector percentages for these sectors rather than small entity percentages

Table 5. Summary of Small Entity Energy Expenditures in the Agriculture Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Revenue		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
1111 – Oilseed and Grain Farming	2,175	8.0	2.6	13.8	3.1
1112 – Vegetable and Melon Farming	261	15.0	0.6	N/A	N/A
1113 – Fruit and Tree Nut Farming	260	6.6	1.0	4.0	0.5
1114 – Greenhouse, Nursery, & Floriculture Production	293	9.9	0.7	4.6	2.9
11191 – Tobacco Farming	91	8.3	1.1	N/A	N/A
11192 – Cotton Farming	218	13.5	0.6	N/A	N/A
11193 – Sugarcane Farming	760	14.4	0.7	N/A	N/A
11194 – Hay Farming	760	14.4	0.7	N/A	N/A
11199 – All Other Crop Farming	760	14.4	0.7	7.8	2.2
11211 – Beef Cattle Ranching & Farming, including Feedlots	2,077	12.7	0.2	10.0	4.2
11212 – Dairy Cattle and Milk Production	632	7.2	0.8	1.7	0.2
1122 – Hog and Pig Farming	196	7.8	0.4	11.5	0.8
1123 – Poultry and Egg Production	463	10.5	0.6	N/A	N/A
1124 – Sheep and Goat Farming	53	17.3	0.6	N/A	N/A
1125 – Animal Aquaculture	395	20.8	1.3	N/A	N/A
1129 – Other Animal Production	395	20.8	1.3	N/A	N/A

Notes: N/A - not available.
Shaded cells indicate that available data for these NAICS codes were reported as a combined total of individual NAICS codes.

Table 6. Summary of Small Entity Energy Expenditures in the Mining Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Revenue		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
211 – Oil and Gas Extraction	2,350	2.4	1.3	24.0	1.1
212 – Mining, Except Oil and Gas	2,641	6.7	0.9	7.5	1.0
213 – Support Activities for Mining	452	2.7	1.0	16.1	1.4

Table 7. Summary of Small Entity Energy Expenditures in the Electric Generation Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Revenue		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
2211 - Electric Power Generation, Transmission & Distribution	2,482	7.3	0.7	N/A	N/A
2211 Public Utilities	1,766	10.0	0.7	N/A	N/A
2211 Private Utilities	716	4.4	0.4	N/A	N/A

Notes: N/A - not available [however, electric d*istribution* sector (NAICS 221122) data generally indicate higher profit margins for smaller-sized firms].

Table 8. Summary of Small Entity Energy Expenditures in the Construction Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Total Value of Business Done		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
236 – Construction of Buildings	3,190	1.6	1.6	4.7	0.9
237 – Heavy and Civil Engineering Construction	1,985	3.3	1.0	9.4	1.4
238 – Specialty Trade Contractors	8,836	2.8	1.1	4.0	1.0

Table 9. Summary of Small Entity Energy Expenditures in the Manufacturing Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Value of Shipments		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
311 - Food Manufacturing	5,744	1.9	2.4	4.1	1.4
312 - Beverage & Tobacco Product Mfg	511	N/A	N/A	8.0	1.2
313 - Textile Mills	1,089	3.3	0.9	1.7	1.2
314 - Textile Product Mills	247	1.0	0.6	3.0	0.8
315 - Apparel Mfg	284	0.8	1.6	2.1	0.4
316 - Leather & Allied Product Mfg	65	1.2	2.4	5.0	1.8
321 - Wood Product Mfg	1,965	2.4	0.9	3.7	0.8
322 - Paper Mfg	N/A	N/A	N/A	2.9	1.0
323 - Printing & Related Support Activities	1,012	1.2	0.8	2.6	0.7
324 - Petroleum & Coal Products Mfg	2,204	2.4	0.8	3.1	0.6
325 - Chemical Mfg	19,439	7.6	1.2	4.8	0.9
326 - Plastics & Rubber Products Mfg	N/A	N/A	N/A	3.1	0.9
327 - Nonmetallic Mineral Product Mfg	4,504	5.2	1.2	4.5	0.7
331 - Primary Metal Mfg	2,976	3.8	0.3	5.2	1.0
332 - Fabricated Metal Product Mfg	N/A	N/A	N/A	4.6	0.9
333 - Machinery Mfg	1,414	0.9	1.5	4.3	0.8
334 - Computer & Electronic Product Mfg	1,583	1.2	2.3	4.8	1.0
335 - Electrical Equipment, Appliance, & Component Mfg	777	1.2	1.9	5.7	1.2
336 - Transportation Equipment Mfg	1,203	0.9	1.9	3.5	0.9
337 - Furniture & Related Product Mfg	437	0.8	0.8	2.7	0.9
339 - Miscellaneous Mfg	687	0.8	1.4	4.5	0.9

Notes: N/A - not available.

Table 10. Summary of Small Entity Energy Expenditures in the Commercial Sector

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
423 - Durable Goods Merchant Wholesalers	2,446	0.3	1.9	0.1	0.03
424 - Nondurable Goods Merchant Wholesalers	2,487	0.3	2.8	1.6	0.8
441 - Motor Vehicle & Parts Dealers	1,564	0.3	3.2	1.3	0.9
442 - Furniture & Home Furnishings Stores	656	0.8	0.7	2.1	1.0
443 - Electronics & Appliance Stores	342	0.6	2.5	2.7	0.9
444 - Building Material & Garden Equipment & Supplies Dealers	1,451	0.9	4.8	2.3	0.6
445 - Food & Beverage Stores	5,578	2.1	53.3	1.8	1.1
446 - Health & Personal Care Stores	N/A	N/A	N/A	3.3	1.6
447 - Gasoline Stations	1,354	0.5	1.2	N/A	0.9
448 - Clothing & Clothing Accessories Stores	N/A	N/A	N/A	2.8	0.7
451 - Sporting Goods, Hobby, Book, & Music Stores	551	0.8	0.4	1.0	0.4
452 - General Merchandise Stores	2,514	4.1	42.5	1.3	0.4
453 - Miscellaneous Store Retailers	742	0.7	0.1	3.2	0.9
454 - Nonstore Retailers	346	0.4	3.0	1.9	0.9
484 - Truck Transportation	15,231	12.3	11.9	4.3	1.2
492 - Couriers & Messengers	1,704	10.8	56.9	2.0	0.9
493 - Warehousing & Storage	122	1.0	1.5	9.2	1.6
511 - Publishing Industries (Except Internet)	61	0.1	7.8	4.7	0.8
512 - Motion Picture & Sound Recording Industries	32	N/A	N/A	4.8	1.0
532 - Rental & Leasing Services	88	0.1	2.5	11.7	1.7
541 - Professional, Scientific, & Technical Services	304	0.1	1.6	7.9	0.7
561 - Administrative & Support Services	377	0.2	2.7	5.6	1.2
562 - Waste management & Remediation Services	116	0.3	2.0	5.1	1.1

Table 10 (continued)

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
621 - Ambulatory Health Care Services	301	0.1	1.0	9.4	1.5
622 - Hospitals	160	4.7	21.3	9.2	2.4
623 - Nursing & Residential Care Facilities	409	0.8	3.7	4.3	1.2
624 - Social Assistance	181	0.2	1.0	3.9	1.9
711 - Performing Arts, Spectator Sports, & Related Industries	49	0.1	3.7	1.9	0.7
712 - Museums, Historical Sites, & Similar Institutions	34	0.8	3.9	0.7	0.1
713 - Amusement, Gambling, & Recreation Industries	273	0.6	2.1	2.8	0.2
721 - Accommodation	3,260	7.1	4.6	8.1	0.7
722 - Food Services & Drinking Places	8,414	2.8	4.9	3.7	1.2
811 - Repair & Maintenance	297	0.2	0.5	3.6	0.8
812 - Personal & Laundry Services	513	0.6	0.9	5.1	1.2
813 - Religious/Grantmaking/Civic/Professional & Similar Org	386	0.4	9.1	6.8	1.1

Notes: N/A - not available

Table 11. Top 10 Sectors with the Highest Small Entity Energy Expenditures

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
325 – Chemical Manufacturing	19,439	7.6	1.2	4.8	0.9
484 – Truck Transportation	15,231	12.3	11.9	3.7	1.0
238 – Specialty Trade Contractors	8,836	2.8	1.1	4.0	1.0
722 – Food Services & Drinking Places	8,414	2.8	4.9	3.7	1.2
311 – Food Manufacturing	5,744	1.9	2.4	4.1	1.4
445 – Food & Beverage Stores	5,578	2.1	53.3	1.8	1.1
327 – Nonmetallic Mineral Product Manufacturing	4,504	5.2	1.2	4.5	0.7
721 – Accommodation	3,260	7.1	4.6	7.2	0.6
236 – Construction of Buildings	3,190	1.6	1.6	4.7	0.9
331 – Primary Metal Manufacturing	2,976	3.8	0.3	5.2	1.0

Table 12. Top 10 Sectors with the Highest Small Entity Energy Expenditures as a Percentage of Sales

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
1125 & 1129 – Animal Aquaculture & Other Animal Production	395	20.8	1.3	N/A	N/A
1124 – Sheep and Goat Farming	53	17.3	0.6	N/A	N/A
1112 – Vegetable and Melon Farming	261	15.0	0.6	N/A	N/A
11193, 1194, & 1199 – Sugarcane, Hay, & All Other Crop Farming	760	14.4	0.7	N/A	N/A
11192 – Cotton Farming	218	13.5	0.6	N/A	N/A
11211 – Beef Cattle Ranching and Farming, including Feedlots	2,077	12.7	0.2	N/A	N/A
484 – Truck Transportation	15,231	12.3	11.9	3.7	1.0
492 – Couriers and Messengers	1,704	10.8	56.9	2.3	1.0
1123 – Poultry and Egg Production	463	10.5	0.6	N/A	N/A
1114 – Greenhouse, Nursery, and Floriculture Production	293	9.9	0.7	4.6	2.9

Notes: N/A – not available.

Table 13. Top 10 Sectors with the Highest Ratio of Small Entity to Large Entity Energy Expenditures to Sales

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
492 – Couriers and Messengers	1,704	10.8	56.9	2.3	1.0
445 – Food & Beverage Stores	5,578	2.1	53.3	1.8	1.1
452 – General Merchandise Stores	2,514	4.1	42.5	1.3	0.4
622 – Hospitals	160	4.7	21.3	7.4	2.0
484 – Truck Transportation	15,231	12.3	11.9	3.7	1.0
813 – Religious/Grantmaking/Civic/ Professional & Similar Org.	386	0.4	9.1	6.6	1.1
511 – Publishing Industries (except Internet)	61	0.1	7.8	5.2	0.9
722 – Food Services and Drinking Places	8,414	2.8	4.9	3.7	1.2
444 – Building Material & Garden Equipment & Supplies Dealers	1,451	0.9	4.8	2.2	0.5
721 – Accommodation	3,260	7.1	4.6	7.2	0.6

Table 14. Top 5 Sectors in Which Small Entities Are Most Vulnerable to Energy Cost Impacts

NAICS Code	Small Entity Energy Expenditures (million $)	Energy Expenditures as % of Sales		Pre-Tax Profit Margin	
		Small Entity (%)	Small Entity/ Large Entity	Small Entity (%)	Small Entity/ Large Entity
492 – Couriers and Messengers	1,704	10.8	56.9	2.3	1.0
11212 – Dairy Cattle and Milk Production	632	7.2	0.8	1.7	0.2
452 – General Merchandise Stores	2,514	4.1	42.5	1.3	0.4
423 – Durable Goods Merchant Wholesalers	2,446	0.3	1.9	0.3	0.08
484 – Truck Transportation	15,231	12.3	11.9	3.7	1.0

Table 15. Total Energy Expenditure Percentages by Fuel Type for Most Vulnerable Sectors

NAICS Code	Small Entity Energy Expenditures (million $)	Percentage of Total Energy Expenditures					
		Electricity	All Fuels	Motor Fuels	Non-Motor Fuels		
					Total	Natural Gas	Other
492 – Couriers and Messengers*	1,704	13.9	86.1	83.3	2.8	2.5	0.4
11212 – Dairy Cattle and Milk Production^	632	43.9	56.1	45.8	10.3	1.3	9.1
452 – General Merchandise Stores	2,514	92.2	7.8	N/A	7.8	6.7	1.1
423 – Durable Goods Merchant Wholesalers	2,446	72.4	27.6	N/A	27.6	25.6	2.0
484 – Truck Transportation*	15,231	3.1	96.9	96.4	0.5	0.5	0.1

* - due to lack of motor fuel expenditure data by size category, NAICS code 484 and 492 data are estimates for the total sector rather than for small entities.
^ - separate motor fuel expenditure estimates are available for diesel (17.2) and gasoline/gasohol (28.6).
N/A - not available.

The study results indicate that the manufacturing and commercial sectors have the greatest potential for small entity energy price impacts. *When measured on the basis of expenditures per value of industry shipments, small entities spent considerably more on energy in 2002 than larger entities in a majority (10 of 17) of the manufacturing sector industries with available data*. The data reveal three manufacturing sector industries as having energy costs per dollar of output that are more than double those incurred by larger entities: food manufacturing; leather and allied products manufacturing; and computer and electronic product manufacturing. Profitability data further indicate the challenges that small entities face from increases in energy and other production input prices: *13 of the 19 manufacturing sector industries with available data have lower baseline profit margins among small entities than large ones.*

Similarly, small entities have higher energy expenditures per dollar of sales than larger entities in 26 of the 31 commercial sector industries studied. The median commercial sector industry has a small entity energy cost per sales ratio that is 2.7 times the ratio of large entities. General merchandise stores; food and beverage stores; and couriers and messengers are three of the commercial sector industries where small entity energy costs per sales ratios are highest relative to their large entity counterparts. The couriers and messengers industry is particularly

noteworthy in that small entity energy expenditures amount to more than 10 percent of total small entity sales. *In addition, data indicate that a majority of commercial sector industries have smaller small entity baseline profit margins than their larger industry counterparts.*

Although the results for other economic sectors (agriculture, mining, construction, electric generation) show a more equal distribution of small and large entity baseline profit margins and energy expenditures per unit of output, all but the electric generation sector have one or more individual industries for which available data suggest that energy price increases are expected to result in greater impacts on small entities than large entities

2. Energy Price Disparities

As noted earlier in the Section B.1 discussion, it appears that the Nguyen and Lee (2002) analysis did not evaluate the possibility that smaller manufacturing sector establishments may face higher energy prices than their larger counterparts. This section provides energy price information by entity size as compiled in this study for the manufacturing, commercial, and electric generation sectors.

Table 16 displays 2002 energy price information by fuel type and employment size category from the 2002 Manufacturing Energy Sector Consumption Survey (MECS). Table 17 converts this information into ratios representing how each employment size category's energy price relates to the overall sector average energy price. This table clearly shows small manufacturing establishments faced higher than average prices in 2002 for electricity, distillate fuel oil, and natural gas. (Coal prices also appear to be higher than average for most of the smaller establishment size categories.)

Table 16. Energy Prices in the Manufacturing Sector by Fuel Type and Establishment Size Category, 2002

Employment Size Category	Dollars per Million Btu					
	Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG and NGL	Coal
Under 50	19.11	3.64	7.38	4.63	5.19	2.15
50-99	17.76	3.62	7.07	4.13	7.07	N/A
100-249	15.51	4.05	6.48	4.1	5.16	1.92
250-499	13.08	3.91	6.43	3.83	6.36	1.77
500-999	12.35	3.51	5.43	3.78	5.75	2.04
1,000 or more	11.72	3.89	5.58	3.6	5.96	1.89
Sector average	14.13	3.78	6.56	3.9	5.84	1.87

Source: E.H. Pechan based on Manufacturing Energy Sector Consumption Survey.
N/A - not available.
LPG and NGL = liquefied petroleum gas and natural gas liquids

Table 17. Comparison of Size Category Price and Average Sector Price in the Manufacturing Sector, 2002

Employment Size Category	Ratio of Employment Size Category Price to Average Sector Price					
	Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG and NGL	Coal
Under 50	1.35	0.96	1.13	1.19	0.89	1.15
50-99	1.26	0.96	1.08	1.06	1.21	N/A
100-249	1.10	1.07	0.99	1.05	0.88	1.03
250-499	0.93	1.03	0.98	0.98	1.09	0.95
500-999	0.87	0.93	0.83	0.97	0.98	1.09
1000 and Over	0.83	1.03	0.85	0.92	1.02	1.01

Source: E.H. Pechan based on Manufacturing Energy Sector Consumption Survey.
Notes: N/A - not available.
LPG and NGL = liquefied petroleum gas and natural gas liquids

Table 18 presents energy prices by fuel type and employment size category as computed from 2003 CBECS microdata.[13] Table 19 displays this information as ratios of each employment size category's average price to the overall commercial sector average price. This table indicates that

[13] See the Commercial Buildings Energy Consumption Survey (CBECS) microdata section of Appendix A for discussion of this data set.

smaller commercial sector entities face higher electricity and natural gas prices than their larger counterparts, with electricity prices up to 30 percent higher for the smallest entities relative to the prices paid by the largest entities.

Table 18. Energy Prices by Fuel Type and Establishment Size Category in the Commercial Sector, 2003

Employment Size Category	Dollars per Million Btu		
	Electricity	Fuel Oil	Natural Gas
0 to 4	32.72	9.94	10.32
5 to 9	30.00	9.21	11.06
10 to 19	27.88	8.79	9.00
20 to 49	26.78	9.79	8.84
50 to 99	24.53	6.57	8.47
100 or more	23.58	9.80	8.29
Sector average	30.98	9.71	10.04

Source: E.H. Pechan based on the Commercial Buildings Energy Consumption Survey.

Table 19. Comparison of Size Category Price and Average Sector Price in the Commercial Sector, 2003

Employment Size Category	Ratio of Employment Size Category Price to Average Sector Price		
	Electricity	Fuel Oil	Natural Gas
0 to 4	1.06	1.02	1.03
5 to 9	0.97	0.95	1.10
10 to 19	0.90	0.91	0.90
20 to 49	0.86	1.01	0.88
50 to 99	0.79	0.99	0.84
100 or more	0.76	1.01	0.83

Source: E.H. Pechan based on the Commercial Buildings Energy Consumption Survey.

Tables 20 and 21 present 2002 energy price information for small and large electric generation sector facilities as developed from EIA data sources.[14] These tables indicate that small utilities in this sector did not generally face energy price disadvantages. (Although a small price disadvantage existed for coal purchases, average natural gas prices were slightly lower for small utilities.)

Table 20. Energy Prices by Fuel Type and Size Category in the Electric Generation Sector, 2002

	Cents per Million Btu			
Size Category	Bituminous Coal	Subbituminous Coal	Distillate Fuel Oil	Natural Gas
Small	167.6	119.0	544.3	345.3
Large	146.0	110.6	537.9	384.4
Sector average	146.3	110.7	538.0	383.7

Notes: Small entities are defined as those that generate no more than 4 million megawatt hours of electricity.
Source: E.H. Pechan based on the U.S. Department of Energy, Energy Information Administration.

Table 21. Comparison of Size Category Price and Average Sector Price in the Electric Generation Sector, 2002

	Ratio of Size Category Price to Average Sector Price			
Size Category	Bituminous Coal	Subbituminous Coal	Distillate Fuel Oil	Natural Gas
Small	1.15	1.07	1.01	0.90
Large	1.00	1.00	1.00	1.00

Notes: Small entities are defined as those that generate no more than 4 million megawatt hours of electricity.
Source: E.H. Pechan based on the U.S. Department of Energy, Energy Information Administration.

[14] See the electric generation (NAICS code 2211) section of Appendix A for a discussion of the development of utility energy prices.

E. SUMMARY/RECOMMENDATIONS FOR FUTURE RESEARCH

Profit margins will be reduced or even eliminated when firms are forced to absorb energy price increases. Reduced profits generally result in cash flow impacts, which may in turn affect firms' access to capital for investments. This is likely to be a particular concern for small firms which have more difficulty in obtaining necessary capital.

This study identifies the industries and energy types for which energy price increases are likely to result in the largest small entity impacts. It finds that small energy price impacts are expected to be most significant in the manufacturing and commercial sectors; the data also indicate that small entities pay substantially higher prices for the major types of energy used in these sectors.

A suggested area for future research is a survey of representative firms in the sectors that have been identified as most severely affected by potential energy price increases. Such a study would seek to determine how firms coped with past energy price increases, what challenges they see ahead from potential future price increases, and how they would plan to respond to various hypothetical percentage increases in energy prices. Such information would provide a better understanding of the unique challenges that small businesses face during times of rising energy prices.

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APPENDIX. ENERGY EXPENDITURE ESTIMATION PROCEDURES

This appendix provides a detailed discussion of the data sources and methods used to characterize energy costs by NAICS code. This discussion is organized by major economic sector.

Agriculture (NAICS codes 111 - 112)

Unlike the manufacturing and commercial sectors, which tend to use number of employees to determine small business status, agricultural NAICS codes generally use revenue data. Therefore, the author computed energy data by revenue size category rather than employee size category.

Steps

(1) Using data from Table 57 (Summary of Combined Government Payments and Market Value of Agricultural Products Sold: 2002) from the 2002 Census of Agriculture, the author computed the proportion of sales by individual revenue category for each reported agricultural sector (e.g., "grains, oilseeds, dry beans, and dry peas" for the $1 million+ revenue category = $5.2 billion / $39.9 billion = 0.1304). Before calculating proportions for the "horses, ponies, mules, burros, and donkeys" sector, the author first added the 2005 total sales values for animal aquaculture from the 2005 Census of Agriculture. (The 2002 Census did not report these data.) This was necessary because the next step requires linking the 2002 Census of Agriculture Table 57 data to Table 59 NAICS code revenue data, and the Table 59 data is reported for the sum of NAICS code 1129 (horses, ponies, mules, burros, and donkeys) and NAICS code 1125 (animal aquaculture) rather than for each individual NAICS code.

(2) The proportions from step 1 were applied to the total revenue estimates by NAICS code found in Table 59 of the 2002 Census of Agriculture. Step 2 results in revenue estimates by agricultural NAICS code for each of 11 revenue size categories.

(3) Compiled NAICS code-level expenditure data representing "total farm production expenses" and "gasoline, fuels, and oils" from Table 59 of the 2002 Census of Agriculture.

(4) Compiled the following data by each of 12 reported farm production specialties (e.g., general cash grains) and economic class ($1 million or greater) from the U.S. Department of Agriculture (USDA)'s "Farm & Operator Households: Structure & Finance," (downloaded from http://www.ers.usda.gov/Data/ARMS/app/Farm.aspx), which is a compilation of data obtained from the Agricultural Resource Management Survey (ARMS): (a) number of farms; (b) gross cash income ($); (c) total cash expenses ($); (d) utilities ($); and (e) fuels and oils ($). the income and expenditure values are reported on a per farm basis.

(5) Using the data compiled in step 4, calculated production specialty/economic class totals by multiplying each per farm income/expenditure value by the applicable number of farms (a).

(6) Summed the income and expenditure category value totals computed in step 5 across economic class to yield income/expense category totals by production specialty.

(7) Where necessary, the author next summed the production specialty-level income and expenditure category estimates computed in step 6 to the Census of Agriculture–reported NAICS code level.

(8) Computed the proportion of total fuels and oils expenditures in each economic class (e.g., 1 million or greater) as computed in step 5 to total fuels and oils expenditures as computed in step 6. For example, assuming that total fuels and oils expenditures are $100 million for the "tobacco, cotton, peanuts" production specialty, and that expenditures from the $500,000 to $999,999 economic class for this specialty are $23 million, then $23 million/$100 million = 0.23 would be the proportion for the $500,000 to $999,999 economic class for the "tobacco, cotton, peanuts" production specialty.

(9) Computed similar economic class proportions to those in step 8 using the "total cash expenses" data computed in step 5.

(10) Applied the proportions computed in step 8 to the "gasoline, fuels, and oils" expenditure totals by NAICS compiled in step 3 to yield estimated expenditures for fuels and oils by NAICS and each of five economic classes. Also, applied the proportions computed in step 9 to the "total farm production expenses" totals by NAICS code as computed in step 3. This yielded estimates for total farm expenses by each of 70 Agricultural Census category/economic class combinations (14 Census categories x 5 economic classes = 70 combinations).

(11) Using the data from step 7, for each Census category/economic class combination, computed the proportion of "total cash expenses" that are "utilities" expenses. This step yielded five economic class proportions for each of the fourteen Census of Agriculture categories.

(12) Applied the proportions from step 11 to the "total farm production expenses" by Census category/economic class combination as computed in step 10 to yield estimates of "utilities" expenditures by Census category/economic class combination.

(13) Summed the NAICS code-level revenue estimates for each of eleven revenue size categories computed in step 2 to match the five economic classes ARMS data first described in step 4.

(14) Computed the following percentages for each Agricultural Census category and economic class combination: (a) total farm production expenses as a percentage of total

revenue; (b) "gasoline, fuels, and oils" expenditures as a percentage of total revenue; and (c) "utilities" expenditures as a percentage of total revenue. Also, prepared the following additional values: total electricity expenditures and the proportion of fuels/oils expenditures by type of fuel/oil.

In addition, the author estimated electricity expenditures by NAICS and economic size class using the following steps:

(1) Compiled the following data for each Agricultural sector NAICS code from the 1997 Census of Agriculture (1997 Census data were used because 2002 Census did not report the necessary data): (a) electricity expenditures ($1,000s); and (b) petroleum products expenditures ($1,000s).

(2) Computed the ratio of electricity expenditures/petroleum product expenditures for each NAICS code.

(3) Multiplied the ratios computed in step 2 by the gas, fuels, and oils expenditures values by NAICS code that were compiled earlier from the 2002 Census of Agriculture. This step yields 2002 estimates of electricity expenditures by NAICS code.

(4) Computed proportions by economic size class from the "utilities" expenditure values that were previously compiled in steps 4 through 6 of the earlier agricultural sector instructions described above.

(5) Multiplied the 2002 electricity expenditure estimates by NAICS code from step 3 by the utilities expenditure proportions from step 4 to yield estimates of electricity expenditures by economic class.

Furthermore, the author estimated fuels/oils expenditures by type of fuel/oil using the following steps:

(1) From the 1997 Census of Agriculture, compiled NAICS-level expenditures for each of the petroleum product subcategories -- i.e.: (a) gasoline and gasohol; (b) diesel fuel; (c) natural gas; and (d) LP gas, fuel oil, kerosene, motor oil, grease, etc. and computed the proportion of total expenditures by subcategory by NAICS code.

(2) For each NAICS code, multiplied the step 1 proportions by the total petroleum products expenditures compiled in step 1 of the electricity expenditures calculation steps.

Mining (NAICS codes 211 - 213)

For 3-digit NAICS code in the mining sector (211, 212, 213), the author:

(1) Compiled the following values by employment size category from the 2002 Census of Mining: (a) total shipments & receipts for services, and (b) total cost of supplies.

(2) Compiled the following values from the 2002 Census of Mining: (a) total cost of supplies, (b) purchased fuels consumed, and (c) purchased electricity. Summed the purchased fuels and purchased electricity values to represent "total energy costs."

(3) Computed the proportion of total cost of supplies that are total energy costs.

(4) Multiplied the proportions from step 3 by the cost of supplies values by employment size category as compiled from step 1. The result is estimated total energy cost by 3-digit NAICS code and employment size category.

(5) Computed the ratios of total energy cost (step 4) to total shipments & receipts for services (from step 1) for each NAICS code/employment size category.

Construction (NAICS codes 236 - 238)

For 3–digit NAICS codes in the Construction sector (236, 237, 238):

(1) Compiled the following values by receipts size category from the 2002 Census of Construction: (a) value of business done, and (b) cost of materials, components, supplies, and fuels.

(2) Compiled the following values by NAICS code from the 2002 Census of Construction: (a) cost of materials, components, and supplies, (b) total cost of power/fuels/lube (this entry does not include cost of on-highway or off-highway fuel), (c) on-highway fuel, and (d) off-highway fuel. values for (a) and (b) were summed together to yield values that match the step 1 receipts size category values reported as "cost of materials, components, supplies, and fuels."

(3) Using the data from step 2, computed the proportion of total cost of power/fuels/lube to total cost of materials, components, supplies and fuels for each NAICS code.

(4) Multiplied the proportions from step 3 by the cost of materials, components, supplies, and fuels values by employment size category as compiled from step 1. This step estimates initial total energy cost (excluding on- and off-highway fuel) by 3-digit NAICS code and receipts size category.

(5) Summed total cost of power/fuels/lube with on-highway fuel and off-highway fuel expenditures from data compiled in step 2, and computed the ratio of total cost of power/fuels/lube to the sum of these three values (hereafter referred to as final total energy cost) for each NAICS code.

(6) Multiplied the ratios from step 5 by the initial total energy cost (excluding on- and off-highway fuel) by NAICS code and receipts size category computed in step 4 to yield final total energy cost by NAICS code and receipts size category.

(7) Computed the ratios of final total energy cost (from step 6) to total value of business done from step 1 for each NAICS code/receipts size category.

(8) Compiled available detailed energy expenditure data from the 2002 Census of Construction by NAICS code, and computed the proportion of final total energy cost by NAICS code for the following (note that data are not available to identify potential energy cost differences by receipts size category): purchased electricity; natural/manufactured gas; gasoline/diesel from other establishments/companies; on-highway fuel; and off-highway fuel.

Electric Generation (NAICS code 2211)

The author computed fuel cost estimates for each individual utility with net electricity generation greater than zero. For public utilities, reflects municipalities, political subdivisions, States, and Federal entities engaged in the generation of electricity that had at least 150,000 megawatthours (MWh) of sales to ultimate consumers and/or at least 150,000 MWh of sales for resale for each of two years prior to 2002. For private utilities, reflects all power plants with a generating capacity of at least one megawatt.

Public and Private Utilities

For utilities with net generation values >0, compiled utility ownership, net generation, and total revenues for 2002 from the Energy Information Administration's Form EIA-861 ("Annual Electric Power Industry Report") database for 2002, accessed from http://www.eia.doe.gov/cneaf/electricity/page/eia861.html.

Public Utilities

(1) Compiled from Form EIA-412 ("Annual Electric Industry Financial Report") database, Schedule 7 ("Electric Operation and Maintenance Costs"), accessed from http://www.eia.doe.gov/cneaf/electricity/page/eia412.html, the following 2002 data: (a) steam power generation fuel cost, and (b) other power generation fuel cost (did not compile nuclear fuel cost information for consistency with private utility data, which does not have this information available).

(2) For each public utility, summed the steam power generation fuel cost with the other power generation fuel cost to yield total fuel cost.

(3) Summed the utility-specific revenue and fuel cost information into two totals: one for utilities with net generation >0 but no more than 4 million megawatthours (SBA definition of small entity for NAICS 2211), and one with utilities >4 million megawatthours. Computed a cost-to-revenue ratio for small utilities and a cost-revenue for large utilities. [Also, computed cost-to-revenue ratios for each individual public utility.]

Private Utilities

(1) Compiled from Form EIA-906 ("Power Plant Report) database (accessed from http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html), monthly and annual fuel consumption by fuel type for each private utility.

(2) Compiled from Form EIA-423 ("Monthly Cost and Quality of Fuels for Electric Plants Report") monthly fuel cost data for each electric power producer (this form is used to obtain data for each electric generating plants whose total steam turbine electric generating capacity and/or combined-cycle generating capacity is 50 or more megawatts.)

(3) Computed the average annual price by utility for the fuel types reported on Form EIA-906 by calculating the average as a weighted average of the Form EIA-423 monthly price values, where the monthly prices are weighted by the Form EIA-423 quantity purchased in each month. In some cases, there was some judgment necessary to assign Form EIA-423 fuel types to Form EIA-906 fuel types.

(4) For Form EIA-906 utility/fuel type combinations for which Form EIA-423 price information was not available, the author developed price estimates. In particular, the author defaulted to price information from one of two sources, listed in order of preference: the June 29, 2006 EIA report "Cost and Quality of Fuels for Electric Plants, 2002 and 2003" or average prices computed from the Form EIA-423 utility specific price data. When the EIA report was used, the author assigned the average fuel price for the state in which the utility is located unless state-level price information was not available, in which case, a regional average price was assigned. If both a state and a regional price were not available, then the author assigned the national average reported price. In cases where no price information was available in the EIA report, the author developed and applied a State-level average price from the Form EIA-423 database information. If the appropriate State was not available from the Form EIA-423 database, the author developed and applied a National-level average price computed from the Form EIA-423 database.

(5) Multiplied the annual fuel price information developed in steps (3) and (4) by the annual fuel consumption estimates compiled in step 1. This step yields fuel costs by utility/fuel type.

(6) Summed the utility-specific revenue and fuel cost information into two totals: one for utilities with net generation >0 but no more than 4 million megawatthours (SBA definition of small entity for NAICS 2211), and one with utilities >4 million megawatthours. Computed a cost-to-revenue ratio for small utilities and a cost-revenue for large utilities. (Also, computed cost-to-revenue ratios for each individual public utility.)

Using the utility-specific cost-to-revenue ratios computed as described above in the Public Utilities and Private Utilities subsections, the author also computed overall electric generation sector cost-to-revenue ratios for the following size categories: (a) 4 million megawatthours or less; and (b) >4 million megawatthours.

Manufacturing (NAICS codes 311 - 339)

Steps used to characterize Manufacturing sector energy costs for 3–digit NAICS codes in the Manufacturing sector (311 - 319):

(1) Compiled data from Table 5 of the 2002 Census of Manufacturers (Census) on the number of employees, value added, value of shipments, and number of establishments by employment size category (1 to 4; 5 to 9; 10 to 19; 20 to 49; 50 to 99; 100 to 249; 250 to 499; 500 to 999; 1,000 to 2,499; 2,500 or more; and total) by 3-digit NAICS code.

(2) Compiled NAICS level data from Table 6.4 of 2002 Manufacturing Energy Consumption Survey (MECS) on total fuel consumption (in Btu) per employee, per dollar of value added, and per value of shipments by employment size category (< 50; 50 to 99; 100 to 249; 250 to 499; 500 to 999; 1,000 and above; and total).

(3) Multiplied each of the fuel use estimates from step 2 by the number of employees, value added, and value of shipments estimates from step 1. Calculated the average of the three estimates and used as the estimate of total fuel use (in Btu) by each of the employment size categories listed above in step 1. For NAICS codes where employment data were withheld, only used the MECS per employee fuel data to estimate fuel consumption (see discussion below of steps used to estimate withheld data).

Estimation of Withheld Employment Data: The Census reports "All Establishments" totals. For all the missing employment categories except the 2,500+ category, the author multiplied the reported number of establishments by the midpoint of the employment range (e.g., NAICS 322 for employment category 1 to 4 employees--multiplied 814 establishments by 2.5 employees = 2,035). For the 2,500+ category, the author used the mid-point associated with the Census's "Number of employees flag" (e.g., NAICS code 322 = 7,499.5). Next, the author subtracted the employment for the employment size categories for which there is no withheld data from the total employees for the NAICS code. This calculation yields total employment for the missing categories. This employment value was then allocated to the missing categories in proportion to the initial employment estimates calculated from the midpoint procedures noted above.

For example, if total employment for NAICS code 322 was 100,000 and the employment for all the categories that are not withheld is 90,000, then 10,000 employees are associated with the withheld employment categories. For the 1 to 4 employment category, 0.213435 of the 10,000 employees would be allocated to this category based on the proportion of employees calculated from the initial employment estimates from each size category [i.e., 2,035 / (2,035 + 7,499.5)]. This procedure would result in an estimated 2,134.35 employees (10,000 * 0.213435 = 2,134.35, rounded = 2,134).

(4) Adjusted the Total fuel consumption estimates computed in step 3 to match the PURCHASED QUANTITY estimates reported in the first column in MECS Table 7.6.

This step was accomplished by multiplying the values in step 3 by the NAICS-level ratios of Table 7.6 "Total Purchased Quantity" values to the NAICS-level sum of total fuel consumption values calculated in step 3.

(5) Estimated Table 7.6 PURCHASED QUANTITY values for each fuel type in trillion Btu terms by multiplying the Table 7.6 physical unit-based values by Btu conversion factors. These Btu conversion factors were as follows: electricity - 0.00342; residual fuel oil - 6.287; distillate fuel oil - 5.825; natural gas - 1.029; LPG and NGL - 3.612; coal - 22.489; and coke and breeze - 22.3. before applying these factors, first estimated the withheld Table 7.6 PURCHASED QUANTITY electricity values (i.e., for NAICS codes 311, 322, 331, 335, and 336) by allocating the total electricity withheld across all NAICS (342,114 million kWh) to these five NAICS based on the proportions represented by the First Use of Energy Net Electricity Btu values reported in MECS Table 1.2.

(6) Computed the proportions of total NAICS-level PURCHASED QUANTITY values for each fuel type from the Btu-based values computed in step 5. In cases where these values are reported as * or W or Q, treated as if 0.

(7) Multiplied the values from step 4 by the proportions from step 6 by linking on NAICS code to estimate NAICS/Fuel Type/Employment Category level fuel PURCHASED QUANTITY estimates in Btu terms.

(8) Estimated the dollars spent on each fuel type by NAICS/Fuel Type/Employment Category using the price per Btu by employment size category data from Table 7.5 in the 2002 MECS.

(9) Using the estimates from step 8, computed proportions by NAICS/fuel type combination of the $ spent by each Employment Size Category.

(10) Multiplied the proportions from step 9 by the Expenditures for Purchased Energy data in Table 7.9 by linking the two data sets on NAICS code and fuel type.

Commercial (NAICS codes 423 - 813)

Economic Census Data

From the various sector specific publications for NAICS codes 42-81 (e.g., Wholesale Trade), the author compiled from AmericanFactFinder (http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=BE0200I101&-_lang=en) by 3-digit NAICS code and following employment size categories: All; All operated entire year, 1, 2, 3 or 4, 5 or 6, 7 to 9, 10 to 14, 15 to 19, 20 to 49, 50 to 99, 100+ employees, and establishments not operated all year (all but NAICS code 55 have data reported for these categories), the following data: (1) Number of Establishments; (2) Sales; and (3) Number of paid employees for pay period including March 12. The author then aggregated/retained these data for the following employment size categories: a) All operated entire year; b) 0 to 4 employees; c) 5-9 employees; d) 10-19 employees; e) 20-49 employees; f) 50-99 employees; and g) 100+ employees.

The author developed energy cost per sales ratios for the NAICS code/employment size categories where Census data were withheld. The author also compiled from the 2002 *Business Expenses Survey* (http://www.census.gov/csd/bes/), values by 3-digit NAICS code for:

(1) Sales
(2) Total Operating Expenses
(3) Cost of purchased electricity
(4) Cost of purchased fuels, excluding motor fuels

Next, the author compared the total sales data between the two data sets to ensure they matched (note that the author did not develop small establishment energy cost information for any NAICS where sales data were provided in the Census, but not in the BES, nor the one case - NAICS 514, where we had sales information from BES, but not from Census). To address discrepancies between sales estimates reported in the 2002 Economic Census and those reported in the 2002 Business Expense Survey (BES), the author adjusted the Census sales estimates to match the BES estimates since the total expenditure and energy expenditure estimates reflect the values reported in the BES. The following identifies the reasons for/approaches used to address these discrepancies.

(a) NAICS codes 423 and 424 - the reason for the large discrepancy is that BES excludes data from manufacturer sales branches and offices (MSBO), while the Census includes these data. Therefore, the author applied the ratio of BES total sales to Census total sales by NAICS code to the Census's employment size category sales estimates (i.e., sales for 0 to 4 employees; c) 5-9 employees; d) 10-19 employees; e) 20-49 employees; f) 50-99 employees; and g) 100+ employees).

(b) With exception of NAICS code 813, all other NAICS codes where sales data are reported in both the Census and the BES have somewhat higher sales estimates in BES than the Census. The reason is that the BES includes establishments without payroll, while the Census does not include these establishments. Again, the author applied the ratio of BES

total sales to Census total sales by NAICS code to the Census's employment size category sales estimates to yield sales estimates that match the BES reported values. The resulting values will be somewhat higher than the Census values.

(c) NAICS code 813 – as a conservative assumption, the author did not make an adjustment to the Census estimates -- even though, unlike Census, BES includes establishments without payroll, Census reported sales greater than BES reported sales (there may have been a revision to estimates that was reflected in one publication, but not the other).

d) All other NAICS codes have sales estimates reported in one publication, but not the other--in all but one case, values are reported in the Census, but not BES. This is generally because either the BES did not include the NAICS within its scope or the BES expenditure estimates did not meet the Bureau of Census's standards. The one exception is NAICS code 514 -- reason why it is in BES, but not Census is because the NAICS was substantially changed between 1997 and 2002, and NAICS code 514 is now comprised of NAICS 51 (partial), 518 (all), and 519 (all). the author did not apply the BES data for 514 to NAICS 516, 518, 519 because it is not an exact match and because these NAICS have very small energy costs as percentage of total operating expenses (electricity is 0.37 percent of total; purchased fuels is 0.03 percent).

Note that after performing the above, and comparing the results to the total BES sales data (which should match), there were four NAICS codes that were not matching (492, 622, 623, 624). This is due to there being withheld data at the employment size category level. The author estimated the sales/establishment for a given employment size category via interpolation or extrapolation of surrounding values, and multiplied this ratio by the reported number of establishments in the size category to yield initial estimated sales by withheld category, and then adjusted these initial estimates to yield values that sum to the total NAICS code sales value.

Commercial Buildings Energy Consumption Survey (CBECS) Microdata

The author compiled detailed data from files 01, 15, and 16 of the 2003 CBECS, which is available from: http://www.eia.doe.gov/emeu/cbecs/cbecs2003/public_use_2003/cbecs_pudata2003.html. Because these data provide records that report estimates from a surveyed group of buildings, and the ADJWT8 field contains weighting factors to represent the national number of buildings associated with each record, the author multiplied the reported data for a given record by the value in the ADJWT8 field (e.g., national electricity expenditures are obtained by multiplying the ELEXP8 field values by the ADJWT8 field values). The individual CBECS files are linked together using values in the PUBID8 field.

The author analyzed the CBECS microdata as follows:

(1) The author added two new fields to the File 01 data -- (1) to contain the estimated number of employees per establishment rounded to the nearest integer; and (2) a flag field to identify employment size per establishment category. For any values from step 1 that may result in errors because NOCC8 field values are 0, the author set the number of

employees per establishment to 0. Next, the author entered the following codes to reflect the values calculated in the first step: 1 = <5 employees/establishment; 2 = 5 to 9 employees/establishment; 3 = 10 to 19 employees/establishment; 4 = 20 to 49 employees/establishment; 5 = 50 to 99 employees/establishment; 6 = 100 or more employees/establishment.

(2) Calculated price per unit of energy by the employment/establishment size categories noted above. Specifically, calculated from File 15 – ELEXP8/ELBTU8 ($ per thousand Btu of electricity); from File 16 – NGEXP8/NGBTU8 ($ per thousand Btu of natural gas), FKEXP8/FKBTU8 ($ per thousand Btu of fuel oil), and DHEXP8/DHBTU8 ($ per thousand Btu of district heat) by employment size category.

(3) Deleted all vacant building records (where the PBA8 field equal to '01'), and all records that report "0" in the number of businesses field (NOCC8).

(4) Calculated the proportion of electricity expenditures by employment size category within each primary business activity (PBA). The author then applied these proportions to the NAICS-level electricity values compiled from the *Business Expenses Survey* (linked PBAs to NAICS codes via the crosswalk table displayed at the end of these steps—using the PBA identified with an '*' to identify the PBA for each 3-digit NAICS code). The result is electricity expenditures by NAICS and employment size category.

(5) Calculated the proportion of the sum of (natural gas expenditures + fuel oil expenditures) by employment size category within each PBA. Multiplied these proportions to the NAICS code-level cost of purchased fuels, excluding motor fuels data compiled from the Business Expenses Survey (note that because CBECS excludes coal, LPG, and biomass, this allocation procedure does not reflect about 5 percent of total commercial sector cost of purchased non-motor fuels). Result is the cost of non-motor fuels by NAICS code and employment size category.

(6) Calculated the proportion of the sum of (natural gas expenditures + fuel oil expenditures) from natural gas expenditures and fuel oil expenditures by PBA. After linking the PBA's to NAICS codes, The author multiplied the estimates from step 5 by these proportions to estimate natural gas expenditures by NAICS code and employment size category, and fuel oil expenditures by NAICS code and employment size category (note that national commercial sector fuel oil expenditures are 85.81 percent distillate; 10.14 percent residual fuel; and 4.04 percent kerosene).

(7) Developed commercial sector energy expenditure estimates by NAICS code and employment size category, and by NAICS code, fuel type, and employment size category.

(8) Developed commercial sector energy consumption expenditures per dollar of sales by NAICS code and employment size category.

Table A-1. Crosswalk Between CBECS Building Types and NAICS Industries

NAICS Code/Description	CBECS Principal Building Activity (PBA) [Category with Asterisk Indicates Most Likely]														
	Education	Food Sales	Food Service	Inpatient Health Care	Outpatient Health Care	Lodging	Retail (non-mall)	Retail (mall)	Office	Public Assembly	Public Order/ Safety	Religious Worship	Service	Warehouse/ Storage	Other
423/durables wholesalers									X					X*	
424/nondurables wholesalers		X							X					X*	
441/motor vehicles & parts dealers							X*	X	X				X	X	
442/furniture/home furnishings stores							X*	X						X	
443/electronics & appliance stores							X*	X						X	
444/building & garden eqpt./supplies							X*	X						X	
445/food & beverage stores		X*													
446/health & personal care stores							X	X*							
447/gasoline stations		X											X*		
448/clothing & accessories stores							X	X*							
451/sports, hobby, book, music stores							X*	X							
452/general merchandise stores							X*	X							
453/other store retailers							X*	X						X	
454/nonstore retailers									X*					X	X
481/air transportation									X	X*			X	X	X
482/rail transportation									X	X*			X	X	
483/water transportation									X	X			X*	X	
484/truck transportation									X				X*	X	
485/transit & ground passenger									X	X*			X	X	
486/pipeline transportation									X*				X	X	
487/scenic & sightseeing transport									X	X*			X	X	
488/transportation support activities									X	X			X*	X	X
491/postal service													X*		
492/couriers and messengers									X				X*	X	
493/warehousing and storage									X					X*	
511/publishing industries									X*					X	
512/motion picture & sound recording									X	X*				X	X
515/broadcasting excluding internet									X	X*					X
516/internet publishing and broadcasting									X*				X	X	
517/telecommunications							X	X	X*				X	X	X
518/internet service providers, etc							X		X*				X	X	X

Table A-1. Crosswalk Between CBECS Building Types and NAICS Industries

NAICS Code/Description	CBECS Principal Building Activity (PBA) [Category with Asterisk Indicates Most Likely]														
	Education	Food Sales	Food Service	Inpatient Health Care	Outpatient Health Care	Lodging	Retail (non-mall)	Retail (mall)	Office	Public Assembly	Public Order/ Safety	Religious Worship	Service	Warehouse/ Storage	Other
519/other information services									X*	X				X	
521/central bank									X*					X	
522/credit intermediation etc.									X*						
523/securities, investments, contracts									X*						
524/insurance carriers etc.									X*						
525/funds, trusts, and other financial									X*						
531/real estate									X*					X	
532/rental & leasing services							X*		X				X	X	
533/lessors of nonfinancial intangibles									X*						
541/professional, scientific, tech services									X*				X		X
551/management of companies etc.									X*						
561/administrative & support services									X*						
562/waste management & remediation									X				X	X	X*
611/educational services	X*	X	X	X	X	X	X		X	X	X	X	X	X	X
621/ambulatory health care services				X	X*				X						
622/hospitals				X*											
623/nursing & residential care facilities						X*									
624/social assistance	X		X		X	X			X*						
711/performing arts, spectator sports etc									X	X*					
712/museums, historical sites, etc.		X	X				X		X	X*					
713/amusement, gambling, recreation		X	X			X	X		X	X*					
721/accommodation			X			X*				X					
722/food services and drinking places			X*												
811/repair and maintenance									X				X*	X	
812/personal and laundry services									X	X			X*		
813/religious, grantmaking, civic, etc.									X			X*			
814/private households															
921/executive, legislative, other gov't.									X*	X	X			X	
922/justice, order, and safety activities									X		X*				
923/administration of programs									X*						
924/administration of environ. programs									X*						

Table A-1. Crosswalk Between CBECS Building Types and NAICS Industries

NAICS Code/Description	CBECS Principal Building Activity (PBA) [Category with Asterisk Indicates Most Likely]														
	Education	Food Sales	Food Service	Inpatient Health Care	Outpatient Health Care	Lodging	Retail (non-mall)	Retail (mall)	Office	Public Assembly	Public Order/ Safety	Religious Worship	Service	Warehouse/ Storage	Other
925/administration of HUD									X*						
926/administration of economic programs									X*						
927/space research and technology									X					X	X*
928/national security & int'l affairs	X	X	X		X				X*					X	X