Georgia Tech | Ivan Allen College
School of Public Policy

Working Paper Series

Working Paper #39

The Residential Energy and Carbon Footprints of the 100 Largest U.S. Metropolitan Areas[1]

Marilyn A. Brown and Elise Logan

May 2008

Corresponding author:

Dr. Marilyn A. Brown
Professor, School of Public Policy
Georgia Institute of Technology
DM Smith Building
685 Cherry Street, Room 312
Atlanta, GA 30332-0345

Email: marilyn.brown@pubpolicy.gatech.edu
Phone 404-385-0303
Fax: 404-385-0504

---

[1] The authors are grateful to the Brookings Institution for sponsoring this research. The guidance and feedback provided by Andrea Sarzynski and Mark Muro are particularly appreciated. In addition, the authors wish to acknowledge and thank Platts Analytics for allowing the Georgia Institute of Technology to use their national database on utility sales, and to Steve Piper and Curt Ophaug-Johansen for working with us to evaluate options for deriving metro-level estimates of electricity consumption.

The Residential Energy and Carbon Footprints of the 100 Largest U.S. Metropolitan Areas

It is becoming increasingly clear that climate change presents a serious global risk demanding an urgent response. With a growing population and an expanding economy, America's settlement area is widening and as it does we are driving more, building more, consuming more energy, and emitting more carbon dioxide. Not surprisingly, how we manage where we live, work and play is emerging as an important issue for our future sustainability and energy security. As a result, many cities are claiming leadership and are committing to climate goals, but without adequate benchmarking and comparative analysis, it is difficult to confirm or refute best practices and policies. For example, relationships between urban land use patterns, energy consumption, and climate-changing greenhouse gas (GHG) emissions are just beginning to be understood and articulated.

With two-thirds of the U.S. population residing in the nation's largest 100 metro areas, urban centers are responsible for a majority of the nation's GHG emissions. At the same time, urban America is the traditional locus of most technology, entrepreneurial, and policy innovations. With access to capital and a highly trained workforce, metropolitan areas have played a leadership role in expanding U.S. business opportunities while solving environmental challenges. For these, and many other reasons, metropolitan areas need to be further stimulated to bring technological and entrepreneurial solutions to the climate change challenge.

To characterize metropolitan contributions to the global climate change problem, this report quantifies the energy consumed and carbon emitted by the 100 largest U.S. metropolitan areas. It does this based on two sources of carbon emissions: (1) the fuels used by vehicles (personal and freight) and (2) the energy used in residential buildings. These are the two largest sources of energy use and GHG emissions in the nation, and they likely also dominate the energy and carbon footprints of urbanized areas – although this remains to be seen and is analyzed for the first time in this report (Figure 1).[2]

The energy and carbon impacts of transportation fuels and energy consumed by residential buildings provide a foundation for exploring the influence of urban form and other determinants of energy use and GHG emissions. How are the energy and carbon footprints of U.S. metropolitan areas impacted by urban form, energy prices, housing stock features, weather, and other variables including state and local policies? As a precursor to answering such important questions, this paper focuses on estimating the size of the energy and carbon footprints of the 100 largest U.S. metropolitan areas.

[2] The 100 largest metropolitan areas were defined by the Brookings Institution based on total employment in 2005. The counties composing these metros are based on the U.S. Census Bureau's definition of Metropolitan Statistical Areas as of December 2003. Thus, our comparison of carbon footprints in the years 2000 and 2005 is based on an identical geographic definition of each metropolitan area.

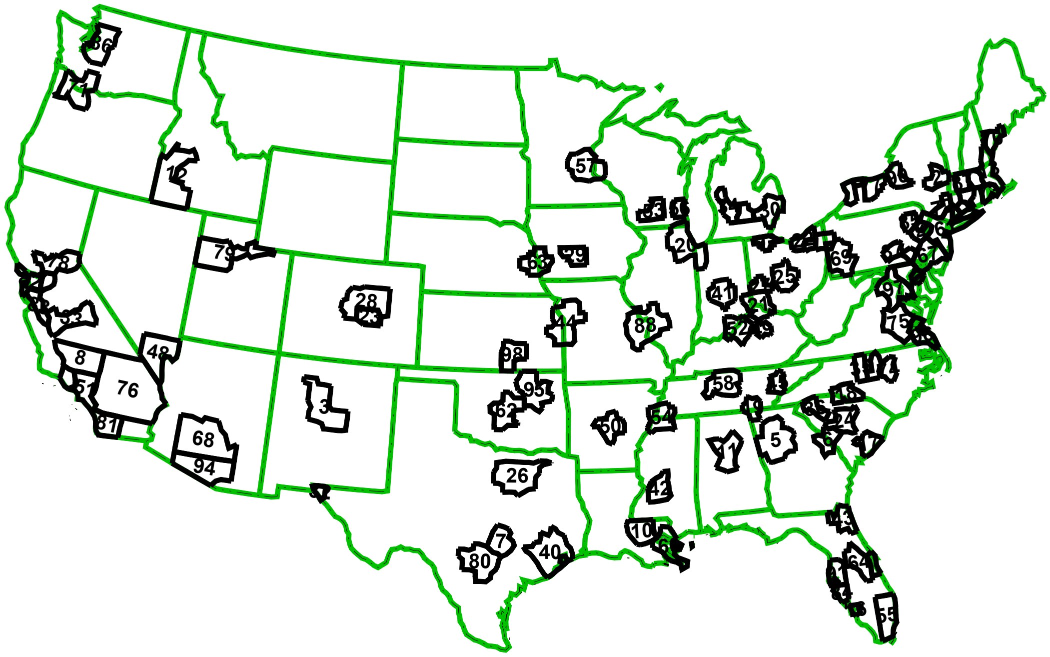
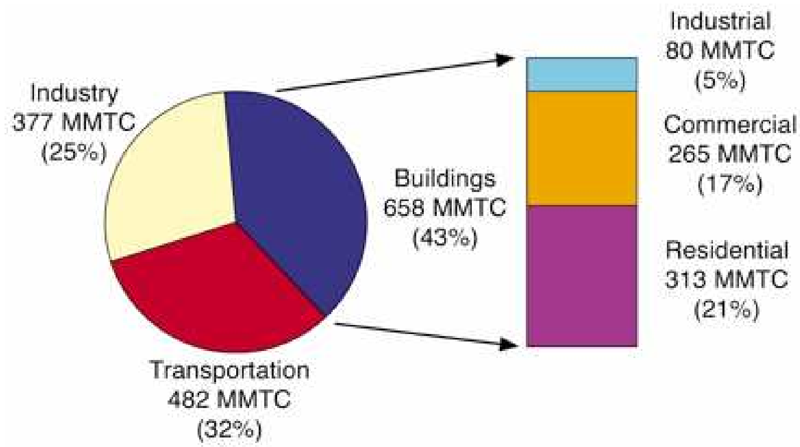


Figure 1. Map of the Top 100 Metropolitan Areas

1 Akron, OH
2 Albany-Schenectady-Troy, NY
3 Albuquerque, NM
4 Allentown-Bethlehem-Easton, PA-NJ
5 Atlanta-Sandy Springs-Marietta, GA
6 Augusta-Richmond County, GA-SC
7 Austin-Round Rock, TX
8 Bakersfield, CA
9 Baltimore-Towson, MD
10 Baton Rouge, LA
11 Birmingham-Hoover, AL
12 Boise City-Nampa, ID
13 Boston-Cambridge-Quincy, MA-NH
14 Bridgeport-Stamford-Norwalk, CT
15 Buffalo-Niagara Falls, NY
16 Cape Coral-Fort Myers, FL
17 Charleston-North Charleston, SC
18 Charlotte-Gastonia-Concord, NC-SC
19 Chattanooga, TN-GA
20 Chicago-Naperville-Joliet, IL-IN-WI
21 Cincinnati-Middletown, OH-KY-IN
22 Cleveland-Elyria-Mentor, OH
23 Colorado Springs, CO
24 Columbia, SC
25 Columbus, OH
26 Dallas-Fort Worth-Arlington, TX
27 Dayton, OH
28 Denver-Aurora, CO
29 Des Moines, IA
30 Detroit-Warren-Livonia, MI
31 Durham, NC
32 El Paso, TX
33 Fresno, CA
34 Grand Rapids-Wyoming, MI
35 Greensboro-High Point, NC
36 Greenville, SC
37 Harrisburg-Carlisle, PA
38 Hartford-West Hartford-East Hartford, CT
39 Honolulu, HI
40 Houston-Baytown-Sugar Land, TX
41 Indianapolis, IN
42 Jackson, MS
43 Jacksonville, FL
44 Kansas City, MO-KS
45 Knoxville, TN
46 Lancaster, PA
47 Lansing-East Lansing, MI
48 Las Vegas-Paradise, NV
49 Lexington-Fayette, KY
50 Little Rock-North Little Rock, AR
51 Los Angeles-Long Beach-Santa Ana, CA
52 Louisville, KY-IN
53 Madison, WI
54 Memphis, TN-MS-AR
55 Miami-Fort Lauderdale-Miami Beach, FL
56 Milwaukee-Waukesha-West Allis, WI
57 Minneapolis-St. Paul-Bloomington, MN-WI
58 Nashville-Davidson--Murfreesboro, TN
59 New Haven-Milford, CT
60 New Orleans-Metairie-Kenner, LA
61 New York-Northern New Jersey-Long Island, NY-NJ-PA
62 Oklahoma City, OK
63 Omaha-Council Bluffs, NE-IA
64 Orlando, FL
65 Oxnard-Thousand Oaks-Ventura, CA
66 Palm Bay-Melbourne-Titusville, FL
67 Philadelphia-Camden-Wilmington, PA-NJ-DE-MD
68 Phoenix-Mesa-Scottsdale, AZ
69 Pittsburgh, PA
70 Portland-South Portland-Biddeford, ME
71 Portland-Vancouver-Beaverton, OR-WA
72 Poughkeepsie-Newburgh-Middletown, NY
73 Providence-New Bedford-Fall River, RI-MA
74 Raleigh-Cary, NC
75 Richmond, VA
76 Riverside-San Bernardino-Ontario, CA
77 Rochester, NY
78 Sacramento--Arden-Arcade--Roseville, CA
79 St. Louis, MO-IL
80 Salt Lake City, UT
81 San Antonio, TX
82 San Diego-Carlsbad-San Marcos, CA
83 San Francisco-Oakland-Fremont, CA
84 San Jose-Sunnyvale-Santa Clara, CA
85 Sarasota-Bradenton-Venice, FL
86 Scranton--Wilkes-Barre, PA
87 Seattle-Tacoma-Bellevue, WA
88 Springfield, MA
89 Stockton, CA
90 Syracuse, NY
91 Tampa-St. Petersburg-Clearwater, FL
92 Toledo, OH
93 Trenton-Ewing, NJ
94 Tucson, AZ
95 Tulsa, OK
96 Virginia Beach-Norfolk-Newport News, VA-NC
97 Washington-Arlington-Alexandria, DC-VA-MD-WV
98 Wichita, KS
99 Worcester, MA
100 Youngstown-Warren-Boardman, OH-PA

Figure 2. Carbon Emissions in the U.S.
Source: Brown, Southworth, and Stovall, 2005



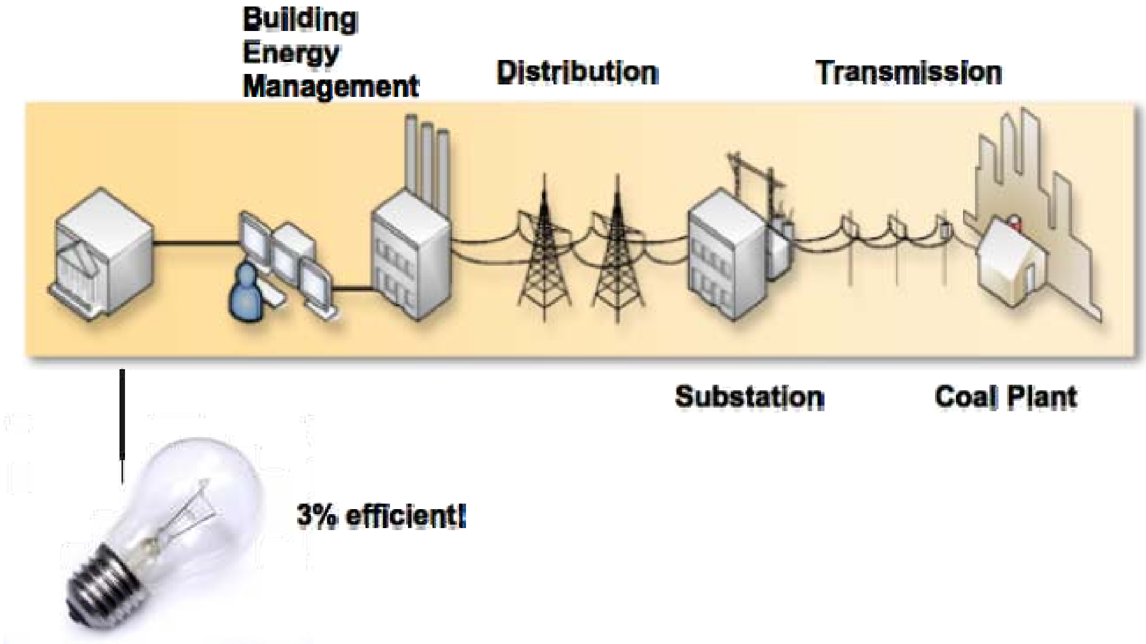
1. Energy Use and Carbon Emissions from Residential Buildings in the United States

In the United States more than half of the energy used by households in their homes comes from the electricity they consume: 56 percent in 2000 and 53 percent in 2005 (Table 1). Specifically, households use electricity for cooling (and some heating), for lighting, and increasingly for televisions, computers, and other household electronics (*Annual Energy Outlook 2007*). Altogether, residential and commercial buildings use 71% of the electricity consumed in the United States.

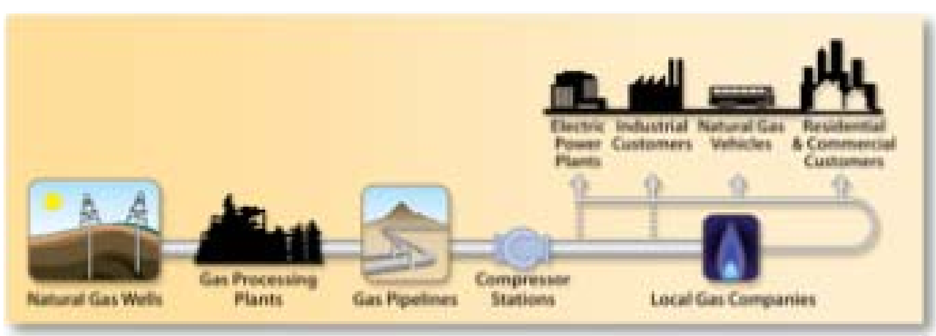
Most electricity in this country is generated from coal at central station power plants. Historically these power plants have operated at about 40% efficiency for more than a half century. Typically, almost two-thirds of the energy embodied in coal is lost through the release of low temperature waste heat either at the power plant or along its route to the end-user (Casten and Ayers, 2007). Depending on how the electricity is ultimately used, as much as 97% of the energy in the coal combusted to produce electricity can be lost as waste heat (see Figure 2). By simply replacing incandescent bulbs with *compact fluorescents*, a four-fold improvement in this 3 percent efficiency could be achieved (Lovins, 2005).

Figure 3. The Energy Consumption of U.S. Buildings

a. Buildings Consume 71% of U.S. Electricity Production



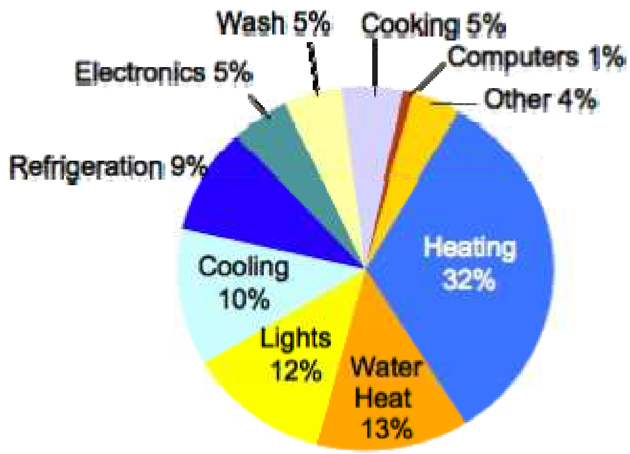
b. Buildings Consume 52% of U.S. Natural Gas Production



The balance of U.S. residential energy consists of direct fuel consumption. Principal among these fuels is natural gas, which is the most common source of space heating in buildings, and is also used for water heating and cooking (see Figure 3). Residential and commercial buildings use 52 percent of U.S. natural gas consumption. Fuel oil is the next most common fuel used in buildings; its use is largely limited to the Northeast and Midwest.

Natural gas is also an increasing contributor to electricity generation, accounting for 18 percent of overall power production in the U.S. today. Virtually all of the plants built over the past decade have been either natural gas combustion turbines or natural gas combined cycle equipment. Because of the lower carbon content of natural gas compared with coal, natural gas has been viewed as a bridge to a more sustainable energy future. However, the past several years have seen increasing natural gas imports and price volatility as domestic production has been unable to keep pace with demand.

Figure 4. Uses of Energy in U.S. Residential Buildings in 2005 (Source: Energy Information Administration, 2007)



1.1 Electricity, Energy and Carbon Totals for the United States

Altogether, 21.7 quadrillion Btu (quads) of energy were consumed by households in the year 2005 at their home or apartment "site." This residential energy consumption was 9.6 percent more than in the year 2000 (Table 1). Since weather strongly impacts the year-to-year changes in residential energy demand and related emissions, it is notable that heating degree-days across the nation in 2000 were approximately 3.4 percent higher than in 2005. The net impact of this difference would be to shrink the differential in residential energy consumption between the two years, especially for natural gas since it is the dominant fuel used for residential space heating.[3]

Over this same period, residential electricity consumption increased at an even faster pace than total residential energy consumption. Specifically, it increased 14.4 percent from 1,193million MWh in 2000 to 1,365 million MWh in 2005. This large increase in electricity use is partly a function of the fact that the year 2005 had 13.7 percent more cooling degree-days than the year 2000, and electricity is the dominant source of air conditioning.[4]

[3] The year 2000 experienced 4,460 heating degree-days, compared with only 4,315 in 2005 (EIA, 2007b, Table 1.7).

[4] Cooling degree-days totaled 1,229 in the year 2000, while in 2005 there were 1,397 (EIA, 2007b, Table 1.8).

The residential electricity "source" energy use (reflecting the heat rate of electricity generation and the thermal content of the electricity consumed on "site") increased by a somewhat higher proportion (15.2 percent) over this same period.[5] This slight increase is due to the slightly higher heat rate of electricity generation in the later year (10,780 Btu/kWh in 2000 compared with 10,850 Btu/kWh in 2005.

Residential fuels are mainly used in home heating, water heating, and cooking. The most common of these fuels are natural gas, fuel oil, kerosene, liquefied petroleum gas (LPG), and wood. Overall residential fuel use was roughly half of electricity use in 2000 based on energy content, and it actually decreased slightly from 2000 to 2005. This decrease occurred because of the significant drop in natural gas use, which was likely caused by rising natural gas prices at the time. Despite the small dip in fuel use, total residential energy use in the United States, including electricity, rose by nearly 10% from 2000 to 2005.

Table 1. Residential Energy Totals for the United States (Quads)

Estimated Annual Totals:	Year 2000	Year 2005	% Change 2000-2005
Residential electricity "source" energy use	12.86 [c]	14.81 [d]	15.2
Residential fuel use	6.96 [c]	6.93 [d]	-0.43
Residential natural gas use	5.14 [c]	4.98 [d]	-3.11
Residential fuel oil use	0.83 [c]	0.93 [d]	12.05
Residential kerosene use	0.09 [c]	0.10 [d]	11.11
Residential LPG use	0.47 [c]	0.51 [d]	8.51
Residential wood use	0.43 [f]	0.41 [f]	-4.65
Residential energy use	19.85 [a]	21.75 [b]	9.6

[a] Sources: *Annual Energy Outlook 2002* (Table A8)
[b] Sources: *Annual Energy Outlook 2007* (Table A8)
[c] Sources: *Annual Energy Outlook 2002* (Table A2). Includes 8.79 quads of electricity-related losses.
[d] Sources: *Annual Energy Outlook 2007* (Table A2). Includes 10.15 quads of electricity-related losses.
[e] Sources: *Annual Energy Outlook 2002* (Table 18)
[f] Sources: *Annual Energy Outlook 2007* (Table 17)

[5] The heat rate of electricity is a measure of generating station thermal efficiency commonly stated as Btu per kWh of electricity. The heat rates for electricity net generation vary year-to-year and region-to-region depending on the mix of electricity generators. In contrast, the value of 3,412 Btu per KWh is generally assumed to be a constant thermal conversion factor for "site" electricity — i.e., for retail sales, including imports and exports (EIA, 2007b, Table A6).

Because a majority of the electricity in the U.S. is generated from coal, which is the most carbon-intensive fossil fuel, the carbon dioxide emissions from residential electricity production and use dominates as a source of carbon emissions in the residential buildings sector. Specifically, electricity is estimated to account for 71 percent of carbon emissions due to residential buildings in 2005, up from 67 percent in the year 2000 (EIA, 2007c, p. 12) (see Table 2).

The increased use of other, dirtier fuels, was enough to offset the decreased natural gas emissions, so that overall emissions from fuel use actually increased by half of a percent. Still, emissions from all categories of fuel grew at significantly slower rates than electricity, between 8.5% and 12% compared to 18.4% growth in electricity.

Total U.S. carbon emissions from energy consumption in residential buildings rose from 306 to 342 MtC (12 percent) between the years 2000 and 2005, largely because of the rapid growth in electricity use (EIA, 2007c, Figure 6 and Table 5). Total U.S. carbon emissions from electricity consumption in residential buildings rose from 204 to 242 MtC over the same five years.

Table 2. Residential Carbon Totals for the United States (million metric tons)

Estimated Annual Totals:	Year 2000	Year 2005	% Change 2000-2005
Carbon from residential electricity "source" energy use	204.0 [a]	241.6 [b]	18.4
Carbon from residential fuel use	100.7	101.3	0.55
Carbon from natural gas use	74.4	72.1	-3.11
Carbon from fuel oil use	16.6	18.6	12.05
Carbon from kerosene use	1.8	2.0	11.11
Carbon from LPG use	8.0	8.7	8.51
Carbon from residential energy use	305.9 [a]	342.0 [b]	11.8

[a] Sources: *Annual Energy Outlook 2002* (Table A19)
[b] Sources: *Annual Energy Outlook 2007* (Table A18)

1.2 Per Capita and Per GDP Footprints for the United States

In the year 2000, the United States had a population of 276.8 million and a GDP of \$11,481 (in billions of \$2005). Thus, the average U.S. resident that year consumed 4.31 MWh of residential electricity, and residential electricity consumption averaged 0.103 MWh for each thousand dollars of GDP (in \$2005).

That "site" electricity footprint translates into an associated "source" energy footprint of 46.5 thousand Btu per person, just over half (56 percent) of the average U.S. residential energy consumption of 71.7 thousand Btu per person. This underscores the dominant role played by electricity consumption in the household's energy budget.

Table 3. Residential Energy Footprints Per Capita and Per GDP for the United States

Estimated Annual Totals:	Per Capita (Mbtu/person)			Per GDP (thousand btu/$2005 GDP)		
	2000	2005	% Change 200-2005	2000	2005	% Change 2000-2005
Residential "source" energy from electricity use	46.5	50.1	7.9	1.12	1.18	5.5
Residential fuel use	25.14	23.45	-6.73	0.61	0.55	-8.77
Residential energy use	71.7	73.6	2.6	1.73	1.74	0.4

By the year 2005, the U.S. population had grown by 6.8 percent to 295.5 million and its GDP increased by 9.2 percent to $12,531 (in billions of $2005). Thus, the average per capita residential electricity consumption was 4.62 MWh, 7.2 percent more than in 2000. This percentage suggests that half of the 14.4 percent growth in residential electricity over this five-year period was due to population growth and half to increased use of electricity per capita. Similarly, the average per GDP residential electricity consumption was 0.109 MWh/$ million GDP, an increase of 4.8 percent.

Per capita "source" energy associated with residential electricity use increased by almost 8 percent over this same period from 46.5 to 50.1 MBtu per capita. Because the use of residential fuels decreased by 6.7%, the total residential energy footprint grew by only 2.6 percent from 71.7 to 73.6 thousand Btu per person. Again, residential fuel use was less than half of electricity use.

Thus, over these five years the country's overall population grew significantly, and each person consumed more energy in their place of residence – especially in the form of electricity. Because the energy required to produce each unit of this expanded residential electricity consumption also increased slightly, the per capita residential electricity "source" energy use increased even more rapidly – by almost 8 percent. Rates of growth of energy use per GDP are more modest since the U.S. economy grew more rapidly than the U.S. population over this period. In fact, total residential energy use per GDP grew by less than half a percent, with the decline in residential fuels nearly canceling out the increase in electricity.

Translating these residential energy consumption footprints into carbon emissions footprints is the final step. Per capita emissions from residential fuels decreased nearly 6%, from .36 metric tons per person in 2000 to .34 in 2005, while electricity emissions continued to grow. The per capita carbon footprint from total residential energy consumption increases from 1.11 metric tons in the year 2000, increasing almost 5 percent to 1.16 metric tons per person in 2005. Approximately two-thirds of this carbon footprint results from residential electricity consumption (0.74 metric tons in 2000 and 0.82 metric tons in 2005, an 11 percent increase).

Table 4. Residential Carbon Footprints Per Capita and Per GDP for the United States

Estimated Annual Totals:	Per Capita (metric tons of carbon/person)			Per GDP (metric tons of carbon/million $2005 GDP)		
	2000	2005	% Change 200-2005	2000	2005	% Change 200-2005
Carbon from residential "source" energy from electricity use	0.74	0.82	10.9	17.8	19.3	8.5
Carbon from residential fuel use	0.36	0.34	-5.77	8.77	8.08	-7.83
Carbon from residential energy use	1.105	1.157	4.7	26.64	27.29	2.4

When normalized by GDP, the carbon footprints from residential energy and electricity consumption increase at lower rates over the five year period, because GDP grows more rapidly than the population. Nevertheless, the carbon intensity of the residential sector (as measured by carbon emissions per $2005 dollar of GDP, does increase – from 26 to 27 metric tons per million GDP for residential energy use, and from 18 to 19 metric tons per million GDP for residential electricity use.

These national electricity, energy and carbon footprints provide benchmarks for comparison with the nation's largest 100 metro areas, which are described in the following section.

2. Electricity, Energy and Carbon Totals for Residential Buildings in the 100 Largest Metro Areas

With approximately two-thirds of the U.S. population residing in the nation's 100 largest metro areas and with nearly three-quarters of the nation's economic activity,[6] one might expect a proportionate contribution to the nation's greenhouse gas emissions. For a variety of reasons, however, a growing body of literature is documenting the energy and greenhouse gas savings that can result from compact urban development. Specifically, it is becoming widely accepted that higher density, more spatially compact and mixed-use developments offer the potential for significant reductions in GHG emissions through three complementary effects:

- Reduced per-unit-area consumption of district energy for cooling, heating, and power generation;
- Reduced municipal infrastructure requirements, including the reduced need for construction of streets and electric, communication, water, and sewage lines, and other services; and
- Reduced VMT, including shorter freight and person trips, as well as the substitution of these trips with public transit, walking, and cycling (Brown, Southworth, and Stovall, 2005).

Most of the literature on urban growth and the environment juxtaposes the performance of "smart growth" with urban sprawl. Typically the focus of these comparisons has been on the transportation sector benefits of well-designed urban development (Ewing, et al., 2008; Burchell, et al., 1998). In comparing the aggregate energy and carbon footprints of metropolitan and non-metropolitan areas, we are more generally comparing urban with rural living conditions. And by focusing on residential and not transportation energy use, a different set of determinants must be examined.

For example, the size, type, and age of housing in metropolitan and non-metropolitan areas are distinct and suggest the possibility that the resident of metropolitan area could have smaller residential energy and greenhouse gas impacts. Housing in urban areas are generally smaller, share common walls and are newer as the result of the rapid expansion of metropolitan populations over the past several decades. With shared walls and generally smaller square footage, households living in buildings with five or more units consume only 38 percent of the energy of households in single-family homes (Brown, Southworth, and Stovall, 2005, Table 1, p. 10). Higher densities also enable greater use of high-efficiency district energy for cooling and heating, lower transmission and distribution line losses, and the possible use of microgrids with distributed power generation that can greatly exceed the 33 percent efficiencies of central plant power systems. Interestingly, the following analysis provides the most thorough estimates of the

---

[6] In the year 2000, 65.6 percent (181.6 million) of the 276.8 million U.S. population resided in the 100 metro areas; in 2005 65.3 percent (193.0 million) of the 295.5 million U.S. population resided in these same metros. The GMP of these 100 metros totaled $9,282 billion in $2005, 74 percent of that year's national GDP.

residential energy and carbon footprints of metropolitan vs. non-metropolitan areas in the United States completed to date.

Appendix A presents the energy and carbon footprints of the largest 100 U.S. metro areas in the years 2000 and 2005 based on estimates of the residential electricity and fuel consumed by households. Each table in this appendix lists the 100 metro areas alphabetically by name down the left-hand column along with estimates of electricity use, energy consumption and carbon emissions in the right-hand columns. Tables A-1 and A-3 present annual estimates of the total residential electricity consumption (in MWh) by metro, the associated energy consumption (in billion Btu), and carbon emissions (in million metric tons) for the years 2000 and 2005, respectively. Tables A-2 and A-4 present these same energy and carbon measures on a per capita basis for the two years. Tables A-5 and A-7 present the total residential fuel consumption (in billion Btu), and carbon emissions (in million metric tons) for the years 2000 and 2005, respectively. Tables A-6 and A-8 present these same energy and carbon measures on a per capita basis for the two years. Tables A-9 and A-11 present the combined total energy use and carbon emissions from electricity and fuel consumption for 2000 and 2005. Tables A-10 and A12 present the per capita energy use and emissions from these totals for the two years.

This section examines the metropolitan area-wide results based on the sums and averages from these tables, and compares these with the national totals and averages. The next section examines variations across individual metropolitan areas.

2.1 Electricity, Energy and Carbon Totals for the 100 Metros

Based on the analysis described in Appendix B, it is estimated that slightly more than half (55 percent) of the overall residential energy consumed in the United States in the years 2000 and 2005 was consumed by residents of the nation's largest 100 metropolitan areas (Table 3).[7] Metro residents consumed a higher proportion of U.S. residential fuels (59 to 60 percent), and a lower proportion of U.S. residential electricity (55 percent in both years).

Similarly, only 52 to 54 percent of total carbon emissions from residential energy was attributable to the residents living within the boundaries of these 100 metropolitan areas. The metro areas accounted for 49 to 53 percent of the carbon emitted from residential electricity use in the U.S. in the years 2000 and 2005, and a somewhat higher percentage of U.S. emissions from residential fuels (60 to 62 percent). Total residential energy use and carbon emissions increased over this 5-year period at rates similar to that of the U.S. total.

[7] Our estimates of the residential electricity consumed in the nation's 100 largest metros are derived from data provided by Platts Analytics. Platts Analytics provided estimates of the total residential MWh sold by each utility that sells electricity to any of the 100 metros, and on the total number of residential customers each utility serves. Platts compiles this data from FERC Form 1 and RUS Form 12, which are filed annually by utilities with the federal government. Appendix B describes the methodology used to convert the Platts data into estimates of the electricity consumed in each metro area, and to convert these estimates into energy consumption and carbon emissions.

Table 5. Residential Electricity and Fuel Energy Totals for 100 Metro Areas (Quads)

Estimated Annual Totals (Percent of U.S. Annual Totals)	Year 2000	Year 2005	% Change 2000-2005
Residential electricity "source" energy use	6.85 (53%)	7.98 (54%)	16.5
Residential Fuel Use	4.16 (60%)	4.08 (59%)	-1.9
Residential natural gas use	3.10 (60%)	3.06 (61%)	-1.3
Residential fuel oil use	.65 (78%)	.63 (68%)	-3.1
Residential kerosene use	.03 (33%)	.03 (30%)	0
Residential LPG use	.21 (45%)	.20 (39%)	-4.8
Residential wood use	.17 (40%)	.17 (41%)	0
Total residential energy use	11.01 (55%)	12.06 (55%)	9.5

*Note: The factors used to convert "site" energy to "source" energy are shown in Table 8 of Appendix B.

Table 6. Carbon Emissions from Residential Electricity and Fuel Energy Totals for 100 Metro Areas (million metric tons)

Estimated Annual Totals (Percent of U.S. Annual Totals)	Year 2000	Year 2005	% Change 2000-2005
Carbon from residential electricity "source" energy use	107.21 (53%)	117.92 (49%)	10.0
Carbon from residential fuel use	61.97 (60%)	60.69 (61%)	-2.1
Carbon from residential natural gas	44.83 (60%)	44.24 (62%)	-1.3
Carbon from residential fuel oil	12.93 (71%)	12.56 (73%)	-2.9
Carbon from residential kerosene	.59 (31%)	.52 (29%)	-11.9
Carbon from residential LPG	3.60 (38%)	3.37 (39%)	-6.4
Carbon from total residential energy use	169.17 (55%)	178.61 (52%)	5.6

The fact that the nation's largest 100 metros account for two-thirds of the U.S. population and three-fourths of its economic activity suggests that the residents of these metropolitan areas have smaller than average per capita and per GMP energy and carbon footprints. This fact is borne out in the following discussion.

2.2 Per Capita and Per GMP Footprints for the 100 Metros

Because the population of a metropolitan area and its level of economic activity are major determinants of energy consumption and carbon emissions, normalizing for these "magnitude" effects helps to uncover differences due to other factors. In keeping with the growing national focus on various energy intensity measures (National Commission on Energy Policy, 2004), this section focuses on residential electricity and fuel use, measured in Btu, and annual carbon emissions in 2000 and 2005, normalized on two dimensions:

- population, and
- gross metropolitan product (GMP).

The population of the 100 largest U.S. metropolitan areas grew by approximately 6.3 percent from 181.6 million in 2000 to 193.0 million in 2005.

GMP is one of several measures of the size of the economy of a metropolitan area. Similar to gross domestic product (GDP), GMP is defined as the market value of all final goods and services produced within a metropolitan area in a given period of time. GMP data were first officially released by the Bureau of Economic Affairs (BEA) in late 2007, when data for 2005 were published. [8] As a result, official estimates are not available for 2000; however, in 2005, the sum of the GMPs for the 100 metros is estimated to be $9,282 in billions of $2005 (which is 74 percent of the nation's $12,531 billion GDP in $2005). The resulting residential electricity, energy and carbon "intensity" measures are listed in Table 4.

On a per capita basis, our study finds that residents of the nation's largest metropolitan areas consume significantly less electricity in their homes than the average U.S. resident. Taken across all 100 metro areas, the average electricity consumed per person was 3.50 MWh in 2000 and 3.81 MWh (or 9 percent more) in 2005. The comparable electricity footprints for the average U.S. resident in the same years were 4.31 and 4.62 MWh – 21 to 23 percent larger than the metropolitan averages.

The energy use associated with the residential electricity consumption in metropolitan areas is comparable. Residents of the 100 largest metro areas used 37.7 MBtu per person in the year 2000 and 41.4 MBtu per person in 2005. This is 21 to 23 percent less than the national averages in the years 2000 (46.5 MBtu) and 2005 (50.1 MBtu). Fuel consumed was 22.9 MBtu per person in 2000 and was 21.1 Mbtu per person in 2005, which is 10 and 11 percent, respectively, less than the nation.

[8] This GMP data can be found at:
http://www.bea.gov/newsreleases/regional/gdp_metro/gdp_metro_newsrelease.htm

Table 7. Per Capita and Per GMP Results for 100 Metro Areas*

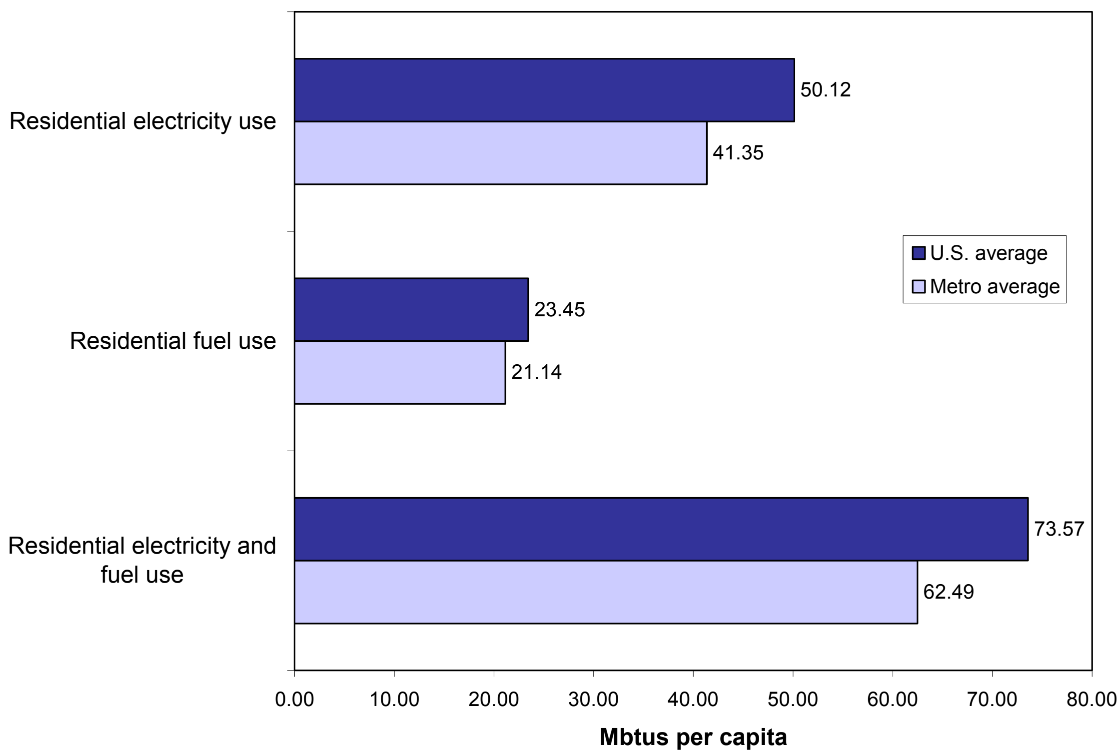
Estimated Annual Energy Totals:	Per Capita (MBtu/person)			Per GMP (thousand Btu/$2005 GDP)
	2000	2005	% Change 2000-2005	2005
Residential "source" energy from electricity use	37.72	41.35	9.6	0.86
Residential fuel use	22.91	21.14	-7.7	0.44
Total residential energy use	60.63	62.49	3.07	1.30
Estimated Annual Carbon Totals:	**Per Capita (metric tons of carbon/person)**			**Per GMP (metric tons of carbon/million $2005 GDP)**
	2000	2005	% Change 2000-2005	2005
Carbon from residential "source" energy from electricity use	0.59	0.61	3.5	12.70
Carbon from residential fuel use	0.34	0.31	-7.9	6.54
Carbon from total residential energy use	0.932	0.925	-0.66	19.24

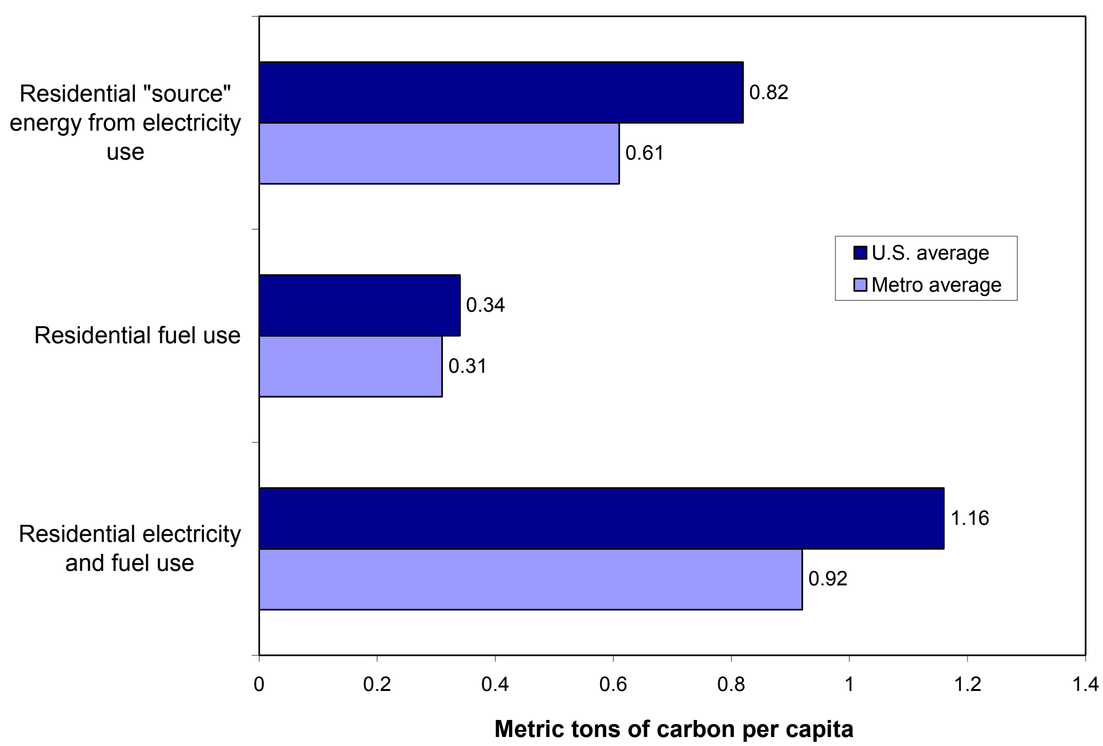
*Note: The factors used to convert "site" energy to "source" energy are shown in Table 8 of Appendix B.

Similarly, residents of the 100 largest metros emitted 0.59 metric tons of carbon in the year 2000 as a result of their residential electricity use, and 0.61 metric tons in the year 2005. Thus, the electricity carbon footprint of the largest metros in the year 2000 is 24 percent smaller than the national average in that year and 33 percent smaller than the national average in 2005. Again, per capita emissions for fuel use declined, from .34 to .31 metric tons. Because residential fuels make up a larger portion of energy use among metro residents than the average U.S. resident, per capita emissions from total residential energy use actually declined from 2000 to 2005.

Since GMP data are not available for year 2000, it is not be possible to compare 2000 and 2005 performance metrics standardized by GMP. In terms of benchmarking for the future, it is notable that in 2005 the 100 largest U.S. metropolitan areas averaged 0.86 MBtu of source energy resulting from electricity use per thousand of $2005 GMP in the year 2005 compared with 1.13 MBtu per million $2005 GDP for the nation. Similarly, these 100 metros emitted an average of 13 metric tons of carbon per $-million of GMP in 2005, significantly (37 percent) smaller than the nationwide average of 19 metric tons. As additional years of GMP data become available, comparisons with these metro-level statistics could become increasingly valuable.

Figure 5. Footprint Comparisons for the U.S. and the Largest 100 Metros, for 2005
(Note: The factor used to convert "site" energy to "source" energy is under review.)





3. Metro-Level Results

There is a growing appreciation that energy and carbon footprints vary over time, generally increasing in magnitude as a country or region grows in economic activity and prosperity. Similarly, energy and carbon footprints can vary greatly across nations, across regions of a country, and within and between urban areas.

For example, the Council on Competitiveness has shown that the energy intensity of the United States is much higher than for many other developed countries. Japan and numerous European countries outperform the U.S. in terms of energy productivity. Although U.S. energy productivity has improved in recent years, it remains approximately two times higher than in Japan. And while China is on a pace to overtake the U.S. and Europe to become the world's largest carbon emitter in approximately 2010, the U.S. is forecast to remain the most CO_2 intensive nation based on the emissions of CO_2 per capita (Council on Competitiveness, 2007).

Certainly it has been known for a long time that energy consumption is tied to the level of economic activity. However, the seemingly inextricable link between energy consumption and economic growth was broken in the decades following the 1973-74 Arab Oil embargo when the energy intensity of the U.S. economy shrank by nearly 50 percent (Brown and Sovacool, 2007). While today's energy and carbon footprints are still impacted by the level of economic activity, they are also shaped by numerous aspects of the physical landscape including the housing stock, transportation system, and industrial production. They are also influenced by other variables including a broad array of diverse state and local policies, by wide-ranging energy prices, and by weather and lifestyle factors. Thus, it is interesting to quantify the variation in energy and carbon footprints across large metropolitan areas and to evaluate the findings in the context of these key variables.

To give a sense of the range of the resulting statistics, Figures 7 through 15 graph the results from highest to lowest. Figure 7 shows the range of annual per person residential energy use, and lists the results for the metros with the 10 highest and 10 lowest carbon per capita averages.[9] Figure 8 presents the results for carbon emissions per capita. Figure 9 presents the carbon emitted per GMP. Figures 10, 11, and 12 show the energy per capita, carbon per capita, and carbon per $ million of GMP, respectively, for residential electricity, in each case sorted from largest to smallest metropolitan footprint. Figures 13, 14, and 15 show the same ranges for residential fuel use.

3.1 Residential Energy Footprints

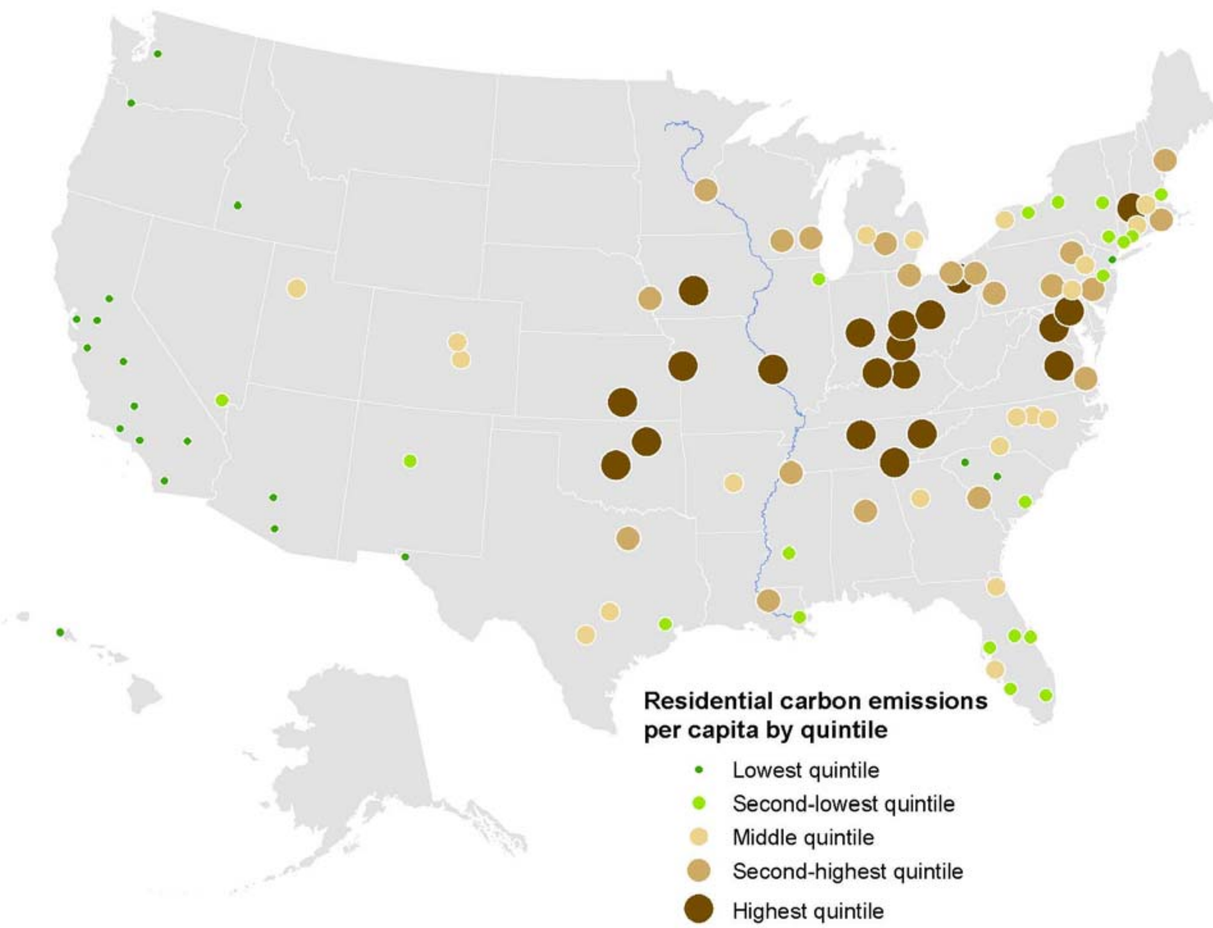
For the year 2005, the residential energy footprints range from a low of less than 25.99 Mbtu per capita (for Honolulu, HI) to a high of 90.96 Mbtu per capita (for Cincinnati-Middletown, OH-KY-IN), representing a ratio of 3.5-to-1. Carbon footprints range from

[9] Complete, sorted tables of all 100 metros are provided in the spreadsheets developed as part of this effort.

1.96 metric tons per person in Washington, D.C. to 0.35 in Bakersfield, CA, representing a ratio of 5.6-to-1. The variation when normalized using $GMP is even greater.

This geographic separation of high and low emitters can be seen clearly in the electricity results. All 10 metros with the largest electricity footprints are located in the Southeast region of the United States or Texas. Metros in the Northeast and California are prominent in the group of ten metros with the lowest electricity footprints. Because residential fuels are used mostly in cold climates, the largest per capita energy consumers are almost entirely located in the Northeast and the lowest in the Sunbelt (Florida, Arizona, and Hawaii).

Figure 6. Per capita carbon emissions from residential energy use, 2005 (metric tons)



3.2 Residential Carbon Footprints

Notable changes among the large and small residential footprints occur when we consider carbon emissions, since the state-specific mix of generation fuels is used to convert MWh of electricity consumption into carbon emissions. The fuel mix used to generate electricity matters in residential footprints. For instance, the Washington, DC, metro area's residential electricity footprint was 10 times larger than Seattle's footprint in 2005. The mix of fuels used to generate electricity in Washington includes high-carbon sources like coal, while Seattle draws its energy primarily from essentially carbon-free hydropower. A high-carbon fuel mix significantly penalizes the Ohio Valley and Appalachian regions, which rely heavily on coal power production. Alternatively, the investor-owned utilities in some states, such as California, no longer purchase electricity from coal power plants, and metro areas have lower carbon footprints.

First consider carbon emissions per capita for electricity. Here the footprints range from a low of 0.154 tons of carbon per capita in the Seattle-Tacoma-Bellevue, WA metro to a high of 1.611 in the Capital area (i.e., the Washington-Arlington-Alexandria, DC-VA-MD-WV metro), representing a 10-to-1 range. The carbon content of the electricity generated in the Capital area is notably high, which pushes its already large footprint of electricity consumption to the upper extreme for carbon emissions per capita. Similarly, the lower-than-average electricity consumption in the Seattle-Tacoma-Bellevue, WA metro was complemented by a low-carbon electricity generation mix dominated by hydroelectric power in the state of Washington.

Weather is another driving factor in the differences seen among metros. Metros located in the coldest cold climates consume 40 times the amount of residential fuels that warm weather metros do (Portland, ME averaged 48.2 MBtu per person in 2005, while Honolulu, HI averaged 0.85). Also, because electricity is used heavily in cooling, warm areas in the South often have large residential footprints because of their heavy reliance on carbon-intensive air conditioning while cold climate metros tend to be lower consumers of electricity. Particularly high-emitting metro areas concentrate throughout the mid-latitude states of the eastern United States where there are substantial combinations of cooling and heating requirements (see Appendix A). Alternatively, the 10 metropolitan areas with the smallest per capita residential footprints are all located along the West Coast, with its milder climate (Figure 6).

Electricity prices also appear to influence the residential footprint. Each of the 10 metro areas with the lowest per capita electricity footprints in 2005 hailed from states with higher-than-average prices, including California, New York, and Hawaii. On the other hand, many Southeastern metro areas with high electricity consumption have had historically low electricity rates.

Finally, an additional set of influences is introduced when carbon emissions are normalized by GMP. The largest residential carbon footprint is found in Louisville, KY-IN with 31.82 tons of carbon per million $GMP. Several Midwest metros are included among the top-ten emitters, reflecting their relatively lower-than-average economic activity per capita. Most of the rest of this group of metros is from the Southeast. The smallest residential carbon emissions when standardized by economic activity is found in Seattle-Tacoma-Bellevue, WA, with 2.71 tons of carbon per million $GMP. The rest of the lowest-emitting metros are located either in California/Washington or are some of the older cities located in the Northeast. Thus, there is almost a 12-to-1 ratio between the metros with the highest and lowest carbon emissions per GMP.

3.3 Regression Analysis of Residential Carbon Footprints

To further probe the factors associated with high versus low carbon emissions profiles, we conducted a multiple regression analysis of per capita residential carbon footprints in 2005. Eight explanatory variables were used. Two of these variables describe a metro area's weather: cooling degree-days and heating degree-days. Another variable is the average electricity price in the metro area's primary state. Four explanatory variables describe a metro area's urban form: population density, housing density, job density, and population concentration. An eighth variable was used to control for each metropolitan area's level of economic productivity. These variables are defined further below.

- Heating degree day (HDD) and cooling degree day (CDD) measure how cold or warm a location is over a year, relative to a reference value of 65°F. State averages are used for each metro, and they are based on the average outside temperature for each day in a year relative to the reference temperature, with negative values set equal to zero.
- Population density, housing density, and job density are the number of persons, housing units, and of jobs per acre of developable land in the metropolitan area. Developable land excludes water bodies and protected lands such as national and state parks.
- Population concentration measures the extent to which persons are evenly distributed across the metro area, using a delta index. The values range from 0 to 1, and higher values indicate less clustering and more even distribution of population.
- Economic productivity is defined as GMP/person.

Complete urban form measures are not available for Bridgeport, CT, Palm Bay, FL, and Honolulu, HI – resulting in a sample size of 97 metro areas for the regression analysis.

In combination, the eight primary explanatory variables explain a majority (56 percent) of the variation in per capita residential carbon footprints across the 97 metro areas. Even without controlling for differences in the carbon content of electricity, the regression model described in Table 8 is highly statistically significant. Specifically, residential carbon footprints are smaller in metro areas with higher concentrations of population, fewer cooling degree-days, fewer heating degree-days, and higher electricity prices.

The analysis of carbon emissions from electricity reveals similar patterns. As Table 9 shows, weather (i.e., heating degree-days and especially cooling degree-days), the price of electricity, and population concentration are strongly correlated with per capita carbon emissions. Controlling for the other variables, a 1 cent/kWh decrease in electricity price results in a 0.07 metric ton increase in per capita emissions per resident. Metro areas with sprawling populations are also not as carbon-efficient as cities with highly concentrated populations.

Table 8. Regression results of metric tons carbon emitted per capita from residential energy use (2005)

Regression Statistics	
Multiple R	0.7710
R Square	0.5944
Adjusted R Square	0.5575
Standard Error	0.2226

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	0.4965	0.3173	1.5649	0.1212
Heating degree days	0.0002	0.0000	7.1097	0.0000
Cooling degree days	0.0003	0.0001	5.6623	0.0000
Electricity price	-0.0439	0.0145	-3.0218	0.0033
GMP/ person	0.0000	0.0000	1.4360	0.1546
Population density	-0.0433	0.2442	-0.1773	0.8597
Housing density	0.0686	0.4299	0.1596	0.8736
Job density	-0.0580	0.4587	-0.1265	0.8997
Population concentration	-0.7766	0.2115	-3.6720	0.0004

Table 9. Regression results of metric tons carbon emitted per capita from residential electricity use (2005)

Regression Statistics	
Multiple R	0.7790
R Square	0.6068
Adjusted R Square	0.5766
Standard Error	0.2162

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	0.8022	0.2771	2.8951	0.0047
Heating degree days	0.0001	0.0000	3.1042	0.0025
Cooling degree days	0.0003	0.0001	5.5762	0.0000
Electricity price	-0.0687	0.0141	-4.8858	0.0000
Population density	-0.1701	0.2182	-0.7797	0.4376
Housing density	0.3131	0.4092	0.7650	0.4463
Job density	0.0772	0.3416	0.2261	0.8216
Population concentration	-0.4653	0.2025	-2.2985	0.0238

The analysis of carbon emissions from residential fuels shows even stronger correlations and even greater explanatory power (Table 10). Heating degree-days but not cooling degree-days are highly correlated with per capita carbon emissions from residential fuels. In combination with population concentration, the regression analysis is able to explain 75 percent of the variation in per capita carbon emissions from residential fuels. Thus, as is true of transportation carbon footprints (Southworth, Sonnenberg, and Brown, 2008), compact metros exhibit lower residential carbon footprints overall, and lower carbon footprints from both residential electricity and residential fuels.

Table 10. Regression results of metric tons carbon emitted per capita from residential fuel use (2005)

Regression Statistics	
Multiple R	0.8766
R Square	0.7684
Adjusted R Square	0.7502
Standard Error	0.0956

	Coefficients	*Std Error*	*t Stat*	*P-value*
Intercept	0.1287	0.1081	1.1897	0.2373
Heating degree days	0.0001	0.0000	9.4033	0.0000
Cooling degree days	0.0000	0.0000	-0.5748	0.5669
GMP/ person	0.0000	0.0000	0.8382	0.4042
Population density	0.1623	0.1009	1.6083	0.1113
Housing density	-0.3693	0.1832	-2.0153	0.0469
Job density	-0.0684	0.1926	-0.3552	0.7233
Population Concentration	-0.3682	0.0866	-4.2534	0.0001

3.4 Regression Analysis of Residential + Transportation Carbon Footprints

We also conducted a multiple regression analysis of the 2005 per capita transportation and residential carbon footprints published in a companion piece by Brown, Southworth and Sarzynski (2008). This companion publication estimates that the average metro area resident's transportation and residential carbon footprint was 2.24 metric tons in 2005 (0.93 from residential energy used and 1.31 from highway transportation energy use). This is 14 percent smaller than the 2.60 metric ton U.S. average in that same year

Eight explanatory variables were used in this regression analysis, including six from the previous regressions reported in Tables 8 to 10. Instead of housing density and job density, we included a dummy variable for rail transit and an estimate of metro population.

- Rail Transit Dummy: =1 if metro area contains at least 10 miles of rail transit (Heavy Rail, Commuter Rail or Light Rail) service; = 0 Otherwise. Thirty of the top 100 metros were identified with this rail transit characteristic (Southworth, Sonnenberg, and Brown 2008).
- Population of the metropolitan area.

In combination, the eight primary explanatory variables explain almost half (49 percent) of the variation in per capita transportation and residential carbon footprints across the 97 metro areas (Table 11). Specifically, residential carbon footprints are smaller in metro areas with higher population concentrations and higher population densities, fewer cooling degree-days, fewer heating degree-days, higher electricity prices, and at least 10 miles of rail transit. Controlling for the other seven variables, the regression analysis estimates that each additional person per square acre of developable land decreases the average per capita carbon footprint by 0.18 metric tons or 8 percent.

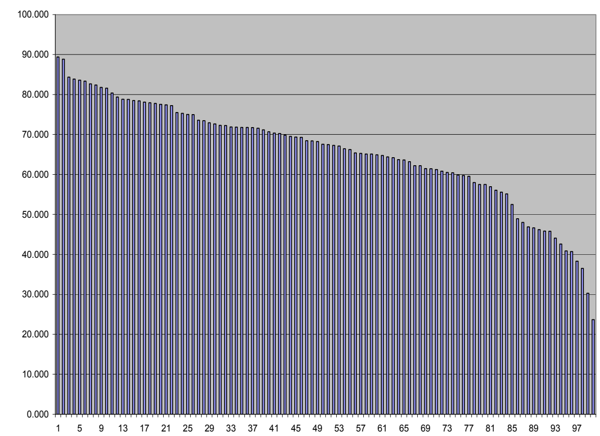
Table 11. Regression results of metric tons carbon emitted per capita from highway transportation and residential energy use (2005)

Regression Statistics	
Multiple R	0.7318
R Square	0.5355
Adjusted R Square	0.4933
Standard Error	0.3515

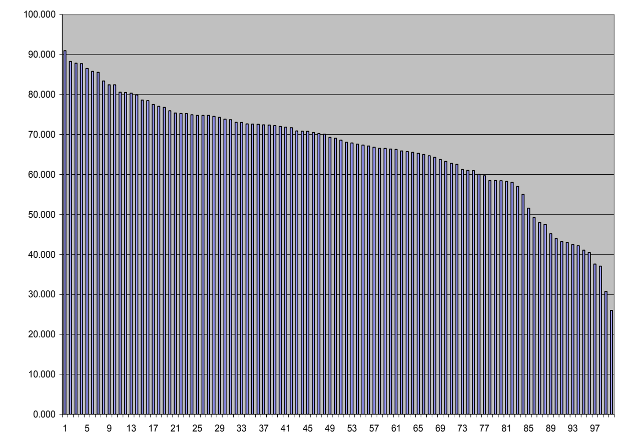
	Coefficients	***Std Error***	***t Stat***	***P-value***
Intercept	3.1909	0.5136	6.2123	0.0000
Heating degree days	0.0001	0.0000	2.5555	0.0123
Cooling degree days	0.0002	0.0001	2.3213	0.0226
Electricity price	-0.0733	0.0226	-3.2405	0.0017
Metro population	0.0000	0.0000	0.8555	0.3946
Population density	-0.1758	0.0516	-3.4093	0.0010
Rail transit dummy	-0.1975	0.1010	-1.9560	0.0536
GMP/person	0.0000	0.0000	1.2540	0.2132
Population concentration	-1.4209	0.3359	-4.2307	0.0001

Figure 7. Per Capita Energy Consumption from Residential Electricity and Fuel Use by Metropolitan Area in 2000 and 2005 (MBtu/person)

2000



2005

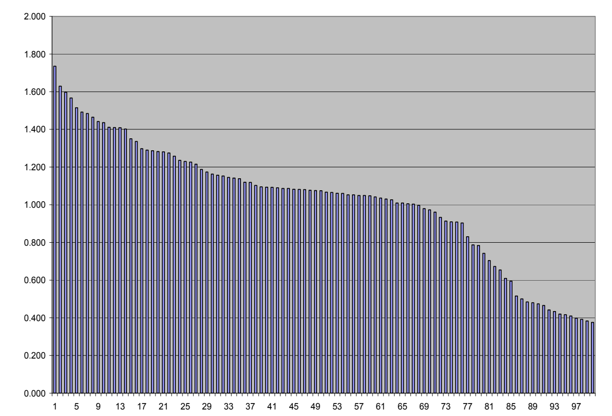


Ten Highest and Ten Lowest Metros

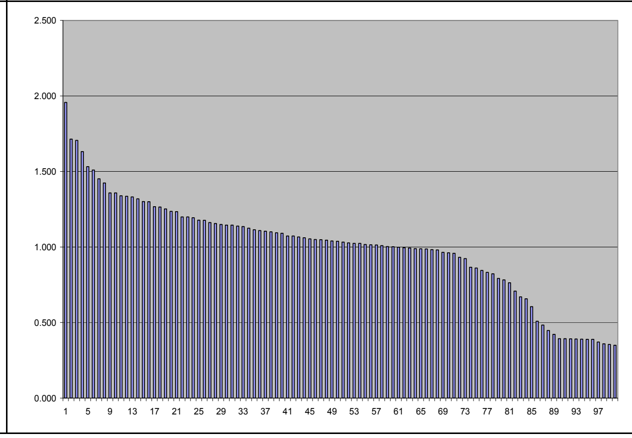
Year 2000	Mbtu/ person	Year 2005	Mbtu/ person
Highest Emitters:		**Highest Emitters:**	
Youngstown-Warren-Boardman, OH-PA	89.409	Cincinnati-Middletown, OH-KY-IN	90.963
Albany-Schenectady-Troy, NY	88.851	Providence-New Bedford-Fall River, RI-MA	88.315
Lansing-East Lansing, MI	84.350	Springfield, MA	87.843
Grand Rapids-Wyoming, MI	83.856	Nashville-Davidson--Murfreesboro, TN	87.735
Buffalo-Niagara Falls, NY	83.609	Baltimore-Towson, MD	86.526
Syracuse, NY	83.350	Washington-Arlington-Alexandria, DC-VA-MD-WV	85.783
Harrisburg-Carlisle, PA	82.685	Richmond, VA	85.547
Nashville-Davidson--Murfreesboro, TN	82.386	Knoxville, TN	83.410
Knoxville, TN	81.806	Chattanooga, TN-GA	82.436
Scranton--Wilkes-Barre, PA	81.603	Hartford-West Hartford-East Hartford, CT	82.435
Lowest Emitters:		**Lowest Emitters:**	
New York-Northern New Jersey-Long Island, NY-NJ-PA	45.822	Stockton, CA	43.215
San Francisco-Oakland-Fremont, CA	45.812	Fresno, CA	43.063
Fresno, CA	44.081	Oxnard-Thousand Oaks-Ventura, CA	42.433
Bakersfield, CA	42.578	San Jose-Sunnyvale-Santa Clara, CA	42.152
Oxnard-Thousand Oaks-Ventura, CA	40.856	San Francisco-Oakland-Fremont, CA	41.085
Riverside-San Bernardino-Ontario, CA	40.719	Riverside-San Bernardino-Ontario, CA	40.492
San Diego-Carlsbad-San Marcos, CA	38.294	San Diego-Carlsbad-San Marcos, CA	37.580
Los Angeles-Long Beach-Santa Ana, CA	36.511	Bakersfield, CA	37.086
El Paso, TX	30.317	El Paso, TX	30.684
Honolulu, HI	23.698	Honolulu, HI	25.989

Figure 8. Per Capita Carbon Emissions from Residential Electricity and Fuel Use by Metropolitan Area in 2000 and 2005 (tons of carbon/person)

2000



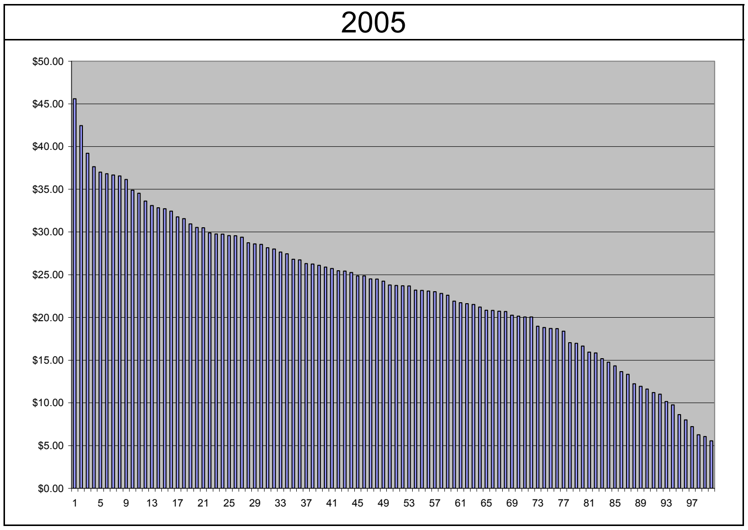
2005



Ten Highest and Ten Lowest Metros

Year 2000	Carbon/ person	Year 2005	Carbon/ Person
Highest Emitters:		**Highest Emitters:**	
Washington-Arlington-Alexandria, DC-VA-MD-WV	1.735	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.958
Lexington-Fayette, KY	1.629	Lexington-Fayette, KY	1.715
Indianapolis, IN	1.597	Cincinnati-Middletown, OH-KY-IN	1.706
Youngstown-Warren-Boardman, OH-PA	1.567	Indianapolis, IN	1.632
Louisville, KY-IN	1.515	Louisville, KY-IN	1.532
Tulsa, OK	1.492	St. Louis, MO-IL	1.510
Oklahoma City, OK	1.484	Dayton, OH	1.452
Toledo, OH	1.465	Tulsa, OK	1.424
Kansas City, MO-KS	1.442	Baltimore-Towson, MD	1.358
Dayton, OH	1.436	Oklahoma City, OK	1.358
Lowest Emitters:		**Lowest Emitters:**	
San Francisco-Oakland-Fremont, CA	0.466	Stockton, CA	0.394
Fresno, CA	0.442	Portland-Vancouver-Beaverton, OR-WA	0.393
Bakersfield, CA	0.433	Los Angeles-Long Beach-Santa Ana, CA	0.391
Oxnard-Thousand Oaks-Ventura, CA	0.420	San Francisco-Oakland-Fremont, CA	0.390
Riverside-San Bernardino-Ontario, CA	0.417	Fresno, CA	0.390
Boise City-Nampa, ID	0.410	San Jose-Sunnyvale-Santa Clara, CA	0.389
San Diego-Carlsbad-San Marcos, CA	0.398	Riverside-San Bernardino-Ontario, CA	0.372
Portland-Vancouver-Beaverton, OR-WA	0.392	San Diego-Carlsbad-San Marcos, CA	0.360
Seattle-Tacoma-Bellevue, WA	0.383	Seattle-Tacoma-Bellevue, WA	0.356
Los Angeles-Long Beach-Santa Ana, CA	0.376	Bakersfield, CA	0.350

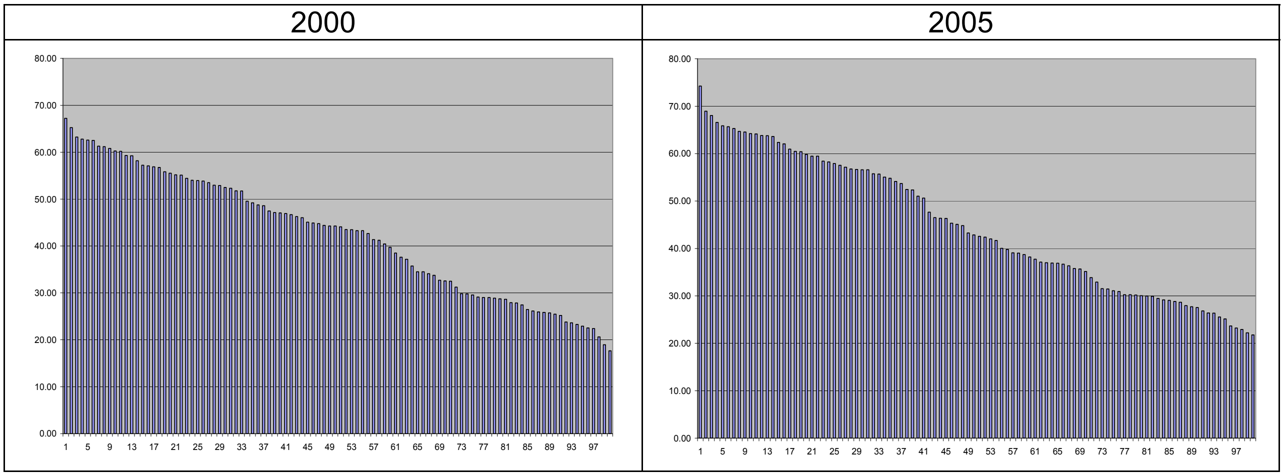
Figure 9. Per GMP Carbon Emissions from Residential Electricity and Fuel Use by Metropolitan Area in 2005 (metric tons of carbon/million $GMP)



Ten Highest and Ten Lowest Metros

Highest Emitters:	**Carbon/ GMP**
Springfield, MA	45.59
Youngstown-Warren-Boardman, OH-PA	42.45
Cincinnati-Middletown, OH-KY-IN	39.21
Dayton, OH	37.65
Louisville, KY-IN	37.01
Lexington-Fayette, KY	36.81
Scranton--Wilkes-Barre, PA	36.67
Augusta-Richmond County, GA-SC	36.56
St. Louis, MO-IL	36.14
Wichita, KS	34.88
Lowest Emitters:	
Honolulu, HI	11.20
Boise City-Nampa, ID	11.01
Sacramento--Arden-Arcade--Roseville, CA	10.17
Oxnard-Thousand Oaks-Ventura, CA	9.76
Portland-Vancouver-Beaverton, OR-WA	8.63
Los Angeles-Long Beach-Santa Ana, CA	8.01
San Diego-Carlsbad-San Marcos, CA	7.22
Seattle-Tacoma-Bellevue, WA	6.27
San Francisco-Oakland-Fremont, CA	6.05
San Jose-Sunnyvale-Santa Clara, CA	5.56

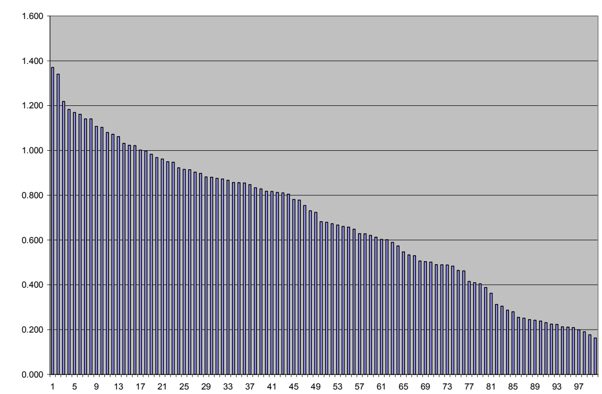
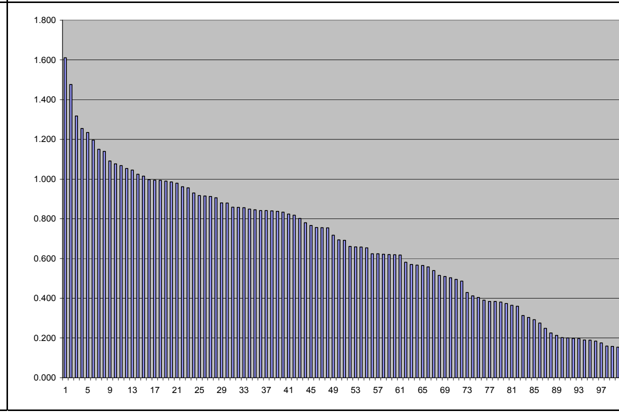
Figure 10. Per Capita Energy Consumption Associated with Residential Electricity Use, by Metropolitan Area in 2000 and 2005 (Mbtu/person)



Ten Highest and Ten Lowest Metros

Year 2000	MBtu/ person	Year 2005	MBtu/ person
Highest Emitters:		**Highest Emitters:**	
Nashville-Davidson--Murfreesboro, TN	67.201	Nashville-Davidson--Murfreesboro, TN	74.208
Knoxville, TN	65.246	Knoxville, TN	68.907
Tampa-St. Petersburg-Clearwater, FL	63.231	Chattanooga, TN-GA	68.001
Dallas-Fort Worth-Arlington, TX	62.786	Sarasota-Bradenton-Venice, FL	66.580
Sarasota-Bradenton-Venice, FL	62.600	Jacksonville, FL	65.859
Chattanooga, TN-GA	62.531	Richmond, VA	65.658
Baton Rouge, LA	61.294	Charleston-North Charleston, SC	65.292
Birmingham-Hoover, AL	61.191	Tampa-St. Petersburg-Clearwater, FL	64.673
Charleston-North Charleston, SC	60.822	Birmingham-Hoover, AL	64.549
Memphis, TN-MS-AR	60.274	Memphis, TN-MS-AR	64.202
Lowest Emitters:		**Lowest Emitters:**	
Worcester, MA	25.172	Riverside-San Bernardino-Ontario, CA	26.835
Albuquerque, NM	23.814	Albuquerque, NM	26.396
Chicago-Naperville-Joliet, IL-IN-WI	23.618	Portland-South Portland-Biddeford, ME	26.353
San Diego-Carlsbad-San Marcos, CA	23.298	San Francisco-Oakland-Fremont, CA	25.566
Los Angeles-Long Beach-Santa Ana, CA	22.914	Honolulu, HI	25.140
Honolulu, HI	22.552	Detroit-Warren-Livonia, MI	23.639
Trenton-Ewing, NJ	22.385	Bakersfield, CA	23.219
El Paso, TX	20.599	San Diego-Carlsbad-San Marcos, CA	22.914
Portland-South Portland-Biddeford, ME	18.941	El Paso, TX	22.215
New York-Northern New Jersey-Long Island, NY-NJ-PA	17.676	New York-Northern New Jersey-Long Island, NY-NJ-PA	21.775

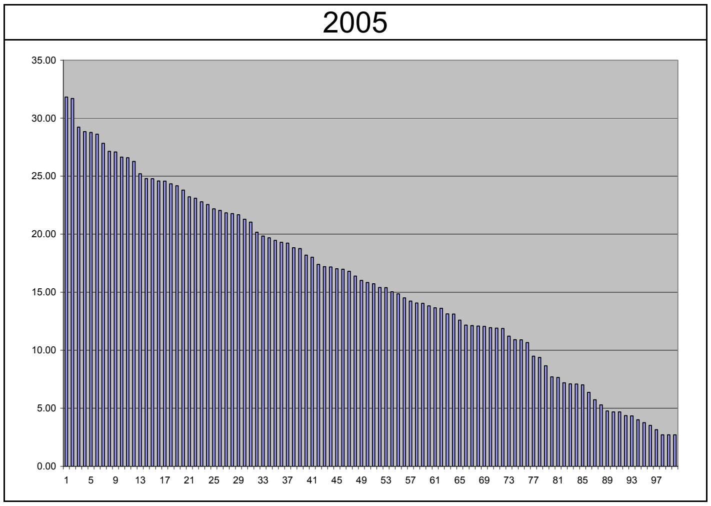
Figure 11. Per Capita Carbon Emissions from Residential Electricity by Metropolitan Area in 2000 and 2005 (tons of carbon/person)

2000	2005
	

Ten Highest and Ten Lowest Metros

Year 2000	Carbon/ person	Year 2005	Carbon/ person
Highest Emitters:		**Highest Emitters:**	
Washington-Arlington-Alexandria, DC-VA-MD-WV	1.371	Washington-Arlington-Alexandria, DC-VA-MD-WV	1.611
Lexington-Fayette, KY	1.341	Lexington-Fayette, KY	1.477
Louisville, KY-IN	1.219	Louisville, KY-IN	1.318
Boise City-Nampa, ID	1.183	Cincinnati-Middletown, OH-KY-IN	1.255
Tulsa, OK	1.170	Indianapolis, IN	1.235
Oklahoma City, OK	1.161	St. Louis, MO-IL	1.195
Indianapolis, IN	1.141	Nashville-Davidson-Murfreesboro, TN	1.150
Nashville-Davidson-Murfreesboro., TN	1.141	Tulsa, OK	1.140
Knoxville, TN	1.107	Boise City-Nampa, ID	1.091
Dallas-Fort Worth-Arlington, TX	1.104	Oklahoma City, OK	1.077
Lowest Emitters:		**Lowest Emitters:**	
LA-Long Beach-Santa Ana, CA	0.231	Stockton, CA	0.200
Bakersfield, CA	0.225	Sacramento--Arden-Arcade--Roseville, CA	0.198
Portland-South Port.-Biddeford, ME	0.223	Portland-Vancouver-Beaverton, OR-WA	0.198
Trenton-Ewing, NJ	0.213	San Jose-Sunnyvale-Santa Clara, CA	0.190
Riverside-San Bernardino-Ontario, CA	0.211	Oxnard-Thousand Oaks-Ventura, CA	0.189
Oxnard-Thousand Oaks-Ventura, CA	0.209	Riverside-San Bernardino-Ontario, CA	0.184
New York-Northern New Jersey-Long Island, NY-NJ-PA	0.199	San Francisco-Oakland-Fremont, CA	0.176
San Diego-Carlsbad-San Marcos, CA	0.191	Bakersfield, CA	0.159
Portland-Vancouver-Beaverton, OR-WA	0.177	San Diego-Carls-San Marcos, CA	0.157
Seattle-Tacoma-Bellevue, WA	0.163	Seattle-Tacoma-Bellevue, WA	0.154

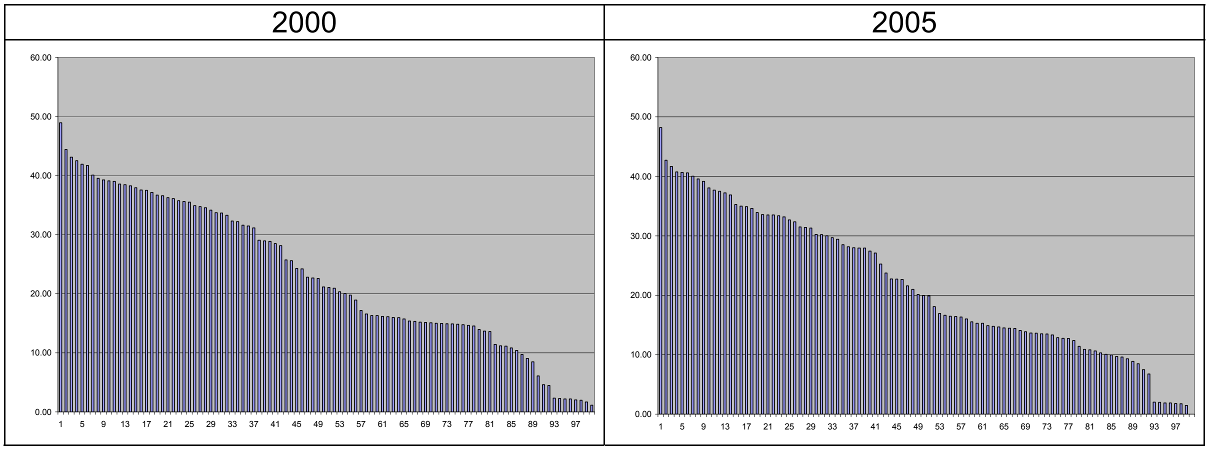
Figure 12. Per GMP Carbon Emissions from Residential Electricity by Metropolitan Area in 2005 (metric tons of carbon/million $GMP)



Ten Highest and Ten Lowest Metros

Highest Emitters:	Carbon/ GMP
Louisville, KY-IN	31.82
Lexington-Fayette, KY	31.70
Augusta-Richmond County, GA-SC	29.23
Cincinnati-Middletown, OH-KY-IN	28.85
Sarasota-Bradenton-Venice, FL	28.77
St. Louis, MO-IL	28.62
Chattanooga, TN-GA	27.84
Youngstown-Warren-Boardman, OH-PA	27.15
Palm Bay-Melbourne-Titusville, FL	27.09
Oklahoma City, OK	26.65
Lowest Emitters:	
Oxnard-Thousand Oaks-Ventura, CA	4.69
Los Angeles-Long Beach-Santa Ana, CA	4.37
Portland-Vancouver-Beaverton, OR-WA	4.34
New York-Northern New Jersey-Long Island, NY-NJ-PA	4.01
Bridgeport-Stamford-Norwalk, CT	3.76
Boise City-Nampa, ID	3.53
San Diego-Carlsbad-San Marcos, CA	3.16
San Francisco-Oakland-Fremont, CA	2.72
San Jose-Sunnyvale-Santa Clara, CA	2.72
Seattle-Tacoma-Bellevue, WA	2.71

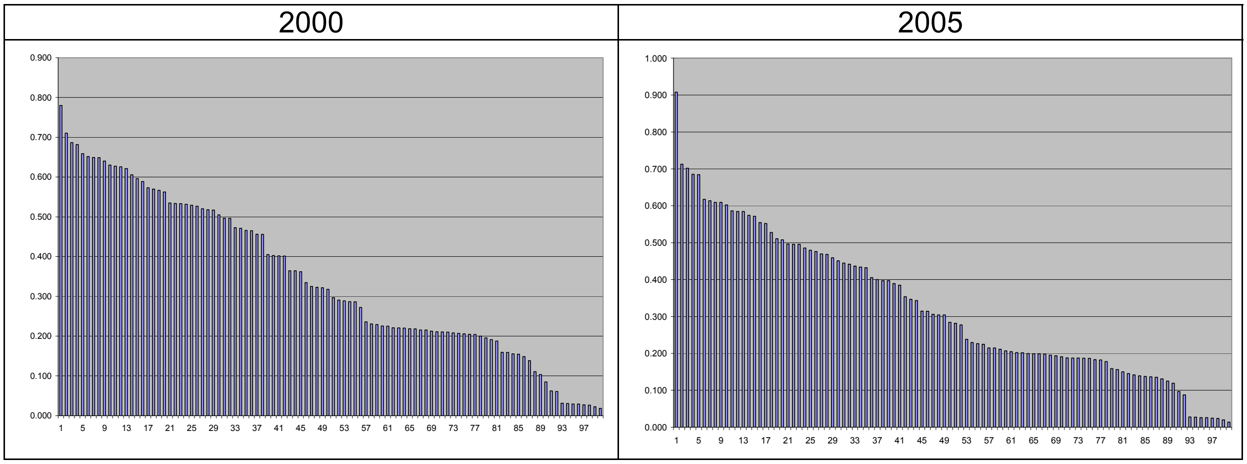
Figure 13. Per Capita Residential Fuel Use, by Metropolitan Area in 2000 and 2005 (Mbtu/person)



Ten Highest and Ten Lowest Metros

Year 2000	Mbtu/ person	Year 2005	Mbtu/ person
Highest Emitters:		**Highest Emitters:**	
Youngstown-Warren-Boardman, OH-PA	48.961	Portland-South Portland-Biddeford, ME	48.200
Detroit-Warren-Livonia, MI	44.425	Detroit-Warren-Livonia, MI	42.729
Lansing-East Lansing, MI	43.135	Lansing-East Lansing, MI	41.667
Grand Rapids-Wyoming, MI	42.511	Hartford-West Hartford-East Hartford, CT	40.771
Portland-South Portland-Biddeford, ME	41.911	Providence-New Bedford-Fall River, RI-MA	40.674
Albany-Schenectady-Troy, NY	41.708	Grand Rapids-Wyoming, MI	40.583
Buffalo-Niagara Falls, NY	40.076	New Haven-Milford, CT	40.038
Hartford-West Hartford-East Hartford, CT	39.544	Buffalo-Niagara Falls, NY	39.553
Springfield, MA	39.281	Bridgeport-Stamford-Norwalk, CT	39.173
New Haven-Milford, CT	39.117	Albany-Schenectady-Troy, NY	38.062
Lowest Emitters:		**Lowest Emitters:**	
Greenville, SC	4.582	Tucson, AZ	7.491
Columbia, SC	4.468	Phoenix-Mesa-Scottsdale, AZ	6.774
Sarasota-Bradenton-Venice, FL	2.335	Sarasota-Bradenton-Venice, FL	2.025
Palm Bay-Melbourne-Titusville, FL	2.272	Palm Bay-Melbourne-Titusville, FL	2.004
Tampa-St. Petersburg-Clearwater, FL	2.184	Tampa-St. Petersburg-Clearwater, FL	1.897
Cape Coral-Fort Myers, FL	2.168	Cape Coral-Fort Myers, FL	1.882
Orlando, FL	2.029	Orlando, FL	1.786
Jacksonville, FL	1.980	Jacksonville, FL	1.757
Miami-Fort Lauderdale-Miami Beach, FL	1.659	Miami-Fort Lauderdale-Miami Beach, FL	1.454
Honolulu, HI	1.146	Honolulu, HI	0.849

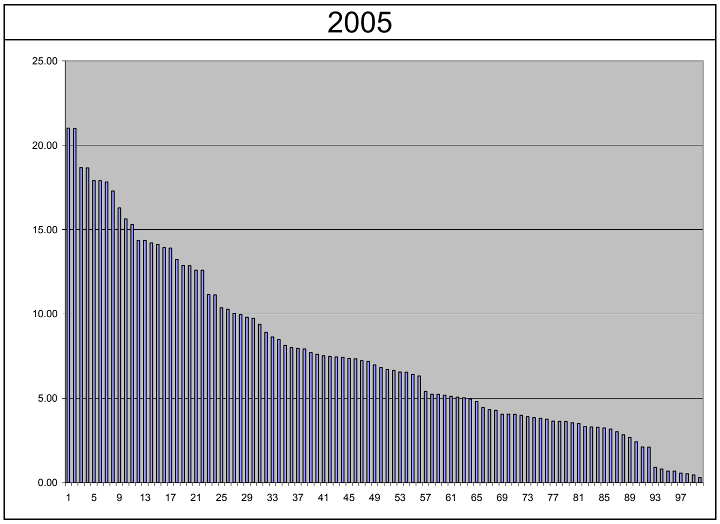
Figure 14. Per Capita Carbon Emissions from Residential Fuel Use by Metropolitan Area in 2000 and 2005 (tons of carbon/person)



Ten Highest and Ten Lowest Metros

Year 2000	Carbon/ person	Year 2005	Carbon/ person
Highest Emitters:		**Highest Emitters:**	
Portland-South Portland-Biddeford, ME	0.780	Portland-South Portland-Biddeford, ME	0.908
Youngstown-Warren-Boardman, OH-PA	0.710	Hartford-West Hartford-East Hartford, CT	0.712
Hartford-West Hartford-East Hartford, CT	0.687	New Haven-Milford, CT	0.702
New Haven-Milford, CT	0.682	Providence-New Bedford-Fall River, RI-MA	0.685
Bridgeport-Stamford-Norwalk, CT	0.659	Bridgeport-Stamford-Norwalk, CT	0.684
Springfield, MA	0.651	Detroit-Warren-Livonia, MI	0.617
Detroit-Warren-Livonia, MI	0.649	Springfield, MA	0.614
Worcester, MA	0.649	Buffalo-Niagara Falls, NY	0.609
Providence-New Bedford-Fall River, RI-MA	0.640	Worcester, MA	0.609
Lansing-East Lansing, MI	0.630	Lansing-East Lansing, MI	0.602
Lowest Emitters:		**Lowest Emitters:**	
Greenville, SC	0.062	Tucson, AZ	0.097
Columbia, SC	0.061	Phoenix-Mesa-Scottsdale, AZ	0.087
Sarasota-Bradenton-Venice, FL	0.031	Sarasota-Bradenton-Venice, FL	0.028
Palm Bay-Melbourne-Titusville, FL	0.031	Palm Bay-Melbourne-Titusville, FL	0.027
Tampa-St. Petersburg-Clearwater, FL	0.029	Tampa-St. Petersburg-Clearwater, FL	0.026
Cape Coral-Fort Myers, FL	0.029	Cape Coral-Fort Myers, FL	0.026
Orlando, FL	0.027	Orlando, FL	0.025
Jacksonville, FL	0.027	Jacksonville, FL	0.024
Miami-Fort Lauderdale-Miami Beach, FL	0.022	Miami-Fort Lauderdale-Miami Beach, FL	0.020
Honolulu, HI	0.018	Honolulu, HI	0.014

Figure 15. Per GMP Carbon Emissions from Residential Fuel Use by Metropolitan Area in 2005 (metric tons of carbon/million $GMP)



Ten Highest and Ten Lowest Metros

Highest Emitters:	Carbon/ GMP
Springfield, MA	21.01
Portland-South Portland-Biddeford, ME	21.00
Providence-New Bedford-Fall River, RI-MA	18.67
Worcester, MA	18.64
Scranton--Wilkes-Barre, PA	17.90
Buffalo-Niagara Falls, NY	17.90
Poughkeepsie-Newburgh-Middletown, NY	17.82
New Haven-Milford, CT	17.28
Lansing-East Lansing, MI	16.29
Syracuse, NY	15.63
Lowest Emitters:	
Houston-Baytown-Sugar Land, TX	2.12
Phoenix-Mesa-Scottsdale, AZ	2.12
Palm Bay-Melbourne-Titusville, FL	0.91
Sarasota-Bradenton-Venice, FL	0.81
Cape Coral-Fort Myers, FL	0.69
Tampa-St. Petersburg-Clearwater, FL	0.68
Jacksonville, FL	0.57
Orlando, FL	0.53
Miami-Fort Lauderdale-Miami Beach, FL	0.47
Honolulu, HI	0.30

5. Conclusions

The nation's carbon footprint has a distinct geography that is not well understood or recognized in the national climate debate, partly because data on GHG emissions are so inadequate. Metros and the built environment are often neglected when solutions to the climate challenge are being discussed, yet they are major carbon emitters and they are poised to be part of the solution.

There is no publicly available national source of data to estimate energy consumption in homes of commercial buildings at the metropolitan scale. The Residential Energy Consumption Survey (RECS) and Commercial Building Energy Consumption Survey (CBECS) provide the foundation of most U.S. building and appliance energy-efficiency analyses. The Energy Information Administration now conducts these analyses every four years. However, the sample sizes are too small to produce reliable estimates at the scale of a metropolitan area (see Brown, Southworth, and Sarzynski, 2008, Appendix B). Because of this lack of publicly available small-area electricity consumption data, the authors obtained proprietary utility sales data from Platts Analytics that could be analyzed by ZIP code and supplemented this with state-level data provided by EIA.

With this data, we quantified and evaluated the residential carbon footprints of the nation's 100 largest metropolitan areas, providing for the first time a set of consistent indices that enable cross-metro comparisons and comparability with national statistics.

Several key findings emerge from our analysis of the residential energy and carbon footprints of the nation's largest 100 metropolitan areas:

- Large metropolitan areas offer greater residential energy and carbon efficiency than nonmetropolitan areas.
- Per capita residential carbon emissions vary substantially by metro area, and the variation is even greater when adjusted for a metro area's economic output.
- Metropolitan areas with the largest per capita residential carbon footprints are predominantly located in the Southeast and Midwest.
- The metropolitan areas with the smallest per capita residential carbon footprints are predominantly located on the West Coast or in the older cities of the Northeast.
- Compact metros have lower per capita residential carbon footprints.
- The fuels used to generate electricity, electricity prices, and weather also are important.

The conclusion that average metropolitan per capita footprints are smaller than the average for nonmetropolitan America suggests that metros are a place where effective carbon reduction strategies may reside. Indeed, many cities are claiming leadership and are committing to climate goals, but without adequate benchmarking and comparative analysis, it is difficult to confirm or refute best practices and policies. By quantifying a consistent set of residential carbon footprints, this report enables the carbon-efficient features of metropolitan areas to be identified and encourages virtuous competition to spur further innovation.

6. References

Brown, M.A., Southworth, F., and A. Sarzynski, 2008. "Shrinking the Carbon Footprint of Metropolitan America," Brookings Institution.

Brown, M.A., Southworth, F., Stovall, T.K., 2005. "Towards a Climate-Friendly Built Environment," Pew Center on Global Climate Change, http://www.pewclimate.org/.

Brown, Marilyn A. and Benjamin K. Sovacool. 2007. "Developing an 'Energy Sustainability Index' to Evaluate Energy Policy," *Interdisciplinary Science Review,* 32 (4): 335-349.

Burchell, R.W. et al. 1998. *The Costs of Sprawl—Revisited. Washington, D.C.: Transportation Research Board.*

Casten, Thomas R. and Robert U. Ayres. 2007. "Energy Myth Eight – Worldwide Power Systems are Economically and Environmentally Optimal," in Sovacool, B. K. and Brown, M. A. (eds.) *Energy and American Society – Thirteen Myths.* (New York: Springer Publishing Company), pp. 201-238.

Council on Competitiveness. 2006. *Competitiveness Index: Where America Stands* (Washington, DC: Council on Competitiveness), available at: http://www.compete.org/store/products.asp.

Energy Information Administration (EIA). 2007a. *Annual Energy Outlook 2007*, Washington, DC: Energy Information Administration, DOE/EIA-0383(2007), February, available at: http://www.eia.doe.gov/oiaf/aeo/

EIA. 2007b. *Annual Energy Review*, Washington, DC: Energy Information Administration, DOE-EIA-0384(2006), June.

EIA. 2007c. *Emissions of Greenhouse Gases in the United States 2006,* Washington, DC: Energy Information Administration, DOE-EIA-0573(2006), November

Ewing, Reid, Keith Bartholomew, Steve Winkelman, Jerry Walters and Don Chen. 2007. *Growing Cooler: The Evidence on Urban Development and Climate Change* (Washington, DC: ULI–the Urban Land Institute), http://www.smartgrowthamerica.org/gcindex.html

Lovins, Amory B., 2005, "More Profit With Less Carbon," *Scientific American* (September), pp. 74–82, www.sciam.com/media/pdf/Lovinsforweb.pdf.

Lovins, Amory B., 2007. "Energy Myth Nine – Energy Efficiency Improvements have Already Reached their Potential," in Sovacool, B. K. and Brown, M. A. (eds.) *Energy and American Society – Thirteen Myths.* (New York: Springer Publishing Company), pp. 239-264.

National Commission on Energy Policy, 2004. *Ending the Energy Stalemate: A Bipartisan Strategy to Meet America's Energy Challenges* (Washington, DC: National Commission on Energy Policy), December.

Southworth, F., A. Sonnenberg, and M.A. Brown. 2008. "The Transportation Eenrgy and Carbon Footprints of the 100 Largest U.S. Metropolitan Area," Georgia Institute of Technology, School of Public Policy Working Paper # 37, (http://www.spp.gatech.edu/faculty/workingpapers.php).

Appendix A

Detailed Tables

Index of Tables

Table A-1. Total Annual Energy Use and Carbon Emissions from Residential Electricity Consumption (Year 2000)

Metro	Residential Electricity Use (MWH)	Energy Use (Btu in billions)	Carbon (million metric tons)
Akron, OH	2,013,621	21,699	0.459
Albany-Schenectady-Troy, NY	3,613,083	38,935	0.438
Albuquerque, NM	1,612,460	17,376	0.419
Allentown-Bethlehem-Easton, PA-NJ	2,974,751	32,056	0.494
Atlanta-Sandy Springs-Marietta, GA	19,167,296	206,547	3.444
Augusta-Richmond County, GA-SC	2,425,194	26,134	0.436
Austin-Round Rock, TX	4,144,363	44,660	0.785
Bakersfield, CA	1,684,780	18,155	0.149
Baltimore-Towson, MD	11,244,328	121,169	1.926
Baton Rouge, LA	4,015,586	43,272	0.679
Birmingham-Hoover, AL	5,975,056	64,387	1.055
Boise City-Nampa, ID	2,103,535	22,668	0.040
Boston-Cambridge-Quincy, MA-NH	11,773,245	126,868	2.039
Bridgeport-Stamford-Norwalk, CT	2,167,894	23,361	0.225
Buffalo-Niagara Falls, NY	4,727,083	50,939	0.573
Cape Coral-Fort Myers, FL	2,426,763	26,151	0.427
Charleston-North Charleston, SC	3,098,841	33,393	0.345
Charlotte-Gastonia-Concord, NC-SC	6,606,543	71,192	1.081
Chattanooga, TN-GA	2,765,205	29,798	0.506
Chicago-Naperville-Joliet, IL-IN-WI	19,941,294	214,887	2.844
Cincinnati-Middletown, OH-KY-IN	8,069,931	86,962	1.841
Cleveland-Elyria-Mentor, OH	5,550,717	59,815	1.266
Colorado Springs, CO	1,448,440	15,608	0.354
Columbia, SC	3,559,155	38,353	0.396
Columbus, OH	5,167,068	55,680	1.179
Dallas-Fort Worth-Arlington, TX	30,073,420	324,071	5.696
Dayton, OH	3,357,847	36,184	0.766
Denver-Aurora, CO	5,731,702	61,765	1.399
Des Moines, IA	1,454,069	15,669	0.394
Detroit-Warren-Livonia, MI	10,719,394	115,512	2.182
Durham, NC	2,259,338	24,347	0.370
El Paso, TX	1,299,162	14,000	0.246
Fresno, CA	2,192,644	23,628	0.194
Grand Rapids-Wyoming, MI	2,841,070	30,615	0.578
Greensboro-High Point, NC	3,214,090	34,635	0.526
Greenville, SC	2,749,285	29,626	0.306
Harrisburg-Carlisle, PA	2,217,096	23,891	0.368
Hartford-West Hartford-East Hartford, CT	3,177,788	34,244	0.330
Honolulu, HI	1,833,578	19,759	0.405
Houston-Baytown-Sugar Land, TX	24,827,291	267,539	4.702
Indianapolis, IN	6,657,410	71,740	1.740
Jackson, MS	2,545,843	27,434	0.412
Jacksonville, FL	6,273,650	67,605	1.104
Kansas City, MO-KS	8,445,960	91,014	1.984
Knoxville, TN	3,730,199	40,197	0.682
Lancaster, PA	1,933,396	20,834	0.321
Lansing-East Lansing, MI	1,712,434	18,453	0.349
Las Vegas-Paradise, NV	5,876,111	63,321	1.108
Lexington-Fayette, KY	2,156,212	23,235	0.547

Table A-1. (cont.)

Metro	Residential Electricity Use (MWH)	Energy Use (Btu billions)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	2,933,856	31,615	0.522
Los Angeles-Long Beach-Santa Ana, CA	26,293,876	283,343	2.324
Louisville, KY-IN	5,578,239	60,111	1.416
Madison, WI	1,300,399	14,013	0.303
Memphis, TN-MS-AR	6,741,132	72,642	1.233
Miami-Fort Lauderdale-Miami Beach, FL	25,071,116	270,166	4.410
Milwaukee-Waukesha-West Allis, WI	4,003,052	43,137	0.932
Minneapolis-St. Paul-Bloomington, MN-WI	8,024,912	86,476	1.586
Nashville-Davidson--Murfreesboro, TN	8,180,485	88,153	1.496
New Haven-Milford, CT	2,000,172	21,554	0.207
New Orleans-Metairie-Kenner, LA	6,991,562	75,341	1.182
New York-Northern NJ-Long Island, NY-NJ-PA	30,056,107	323,885	3.643
Oklahoma City, OK	5,603,296	60,381	1.272
Omaha-Council Bluffs, NE-IA	2,829,410	30,490	0.516
Orlando, FL	8,246,706	88,867	1.451
Oxnard-Thousand Oaks-Ventura, CA	1,782,046	19,203	0.158
Palm Bay-Melbourne-Titusville, FL	2,571,423	27,710	0.452
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	17,162,043	184,938	2.851
Phoenix-Mesa-Scottsdale, AZ	14,094,011	151,877	1.955
Pittsburgh, PA	7,376,818	79,493	1.225
Portland-South Portland-Biddeford, ME	856,996	9,235	0.109
Portland-Vancouver-Beaverton, OR-WA	7,939,761	85,559	0.341
Poughkeepsie-Newburgh-Middletown, NY	2,508,240	27,029	0.304
Providence-New Bedford-Fall River, RI-MA	4,957,291	53,420	0.648
Raleigh-Cary, NC	4,129,212	44,496	0.676
Richmond, VA	5,538,892	59,687	0.940
Riverside-San Bernardino-Ontario, CA	7,772,805	83,760	0.687
Rochester, NY	3,322,459	35,803	0.403
Sacramento--Arden-Arcade--Roseville, CA	4,841,946	52,177	0.428
Salt Lake City, UT	3,462,335	37,310	0.848
San Antonio, TX	8,336,862	89,838	1.579
San Diego-Carlsbad-San Marcos, CA	6,083,535	65,556	0.538
San Francisco-Oakland-Fremont, CA	11,424,680	123,112	1.010
San Jose-Sunnyvale-Santa Clara, CA	5,493,963	59,203	0.486
Sarasota-Bradenton-Venice, FL	3,427,182	36,931	0.603
Scranton--Wilkes-Barre, PA	2,293,143	24,711	0.381
Seattle-Tacoma-Bellevue, WA	12,689,050	136,737	0.496
Springfield, MA	1,631,529	17,581	0.283
St. Louis, MO-IL	12,321,595	132,778	2.894
Stockton, CA	1,944,216	20,951	0.172
Syracuse, NY	2,719,984	29,311	0.330
Tampa-St. Petersburg-Clearwater, FL	14,059,034	151,500	2.473
Toledo, OH	2,738,732	29,513	0.625
Trenton-Ewing, NJ	728,643	7,852	0.075
Tucson, AZ	2,944,432	31,729	0.408
Tulsa, OK	4,429,327	47,730	1.005
Virginia Beach-Norfolk-Newport News, VA-NC	7,744,452	83,454	1.314
Washington-Arlington-Alexandria, DC-VA-MD-WV	20,597,164	221,955	6.575
Wichita, KS	2,346,635	25,287	0.522
Worcester, MA	1,754,218	18,903	0.304
Youngstown-Warren-Boardman, OH-PA	2,263,256	24,389	0.516
Total Top 100 Metros	635,697,451	6,850,276	107.212

Table A-2. Per Capita Annual Energy Use and Carbon Emissions from Residential Electricity Consumption (Year 2000)

Metro	MWh/person	Energy (MBtu/person)	Carbon (metric tons/person)
Akron, OH	2.897	31.223	0.661
Albany-Schenectady-Troy, NY	4.375	47.143	0.530
Albuquerque, NM	2.210	23.814	0.574
Allentown-Bethlehem-Easton, PA-NJ	4.018	43.296	0.667
Atlanta-Sandy Springs-Marietta, GA	4.512	48.622	0.811
Augusta-Richmond County, GA-SC	4.853	52.301	0.872
Austin-Round Rock, TX	3.316	35.735	0.628
Bakersfield, CA	2.546	27.439	0.225
Baltimore-Towson, MD	4.404	47.461	0.754
Baton Rouge, LA	5.688	61.294	0.961
Birmingham-Hoover, AL	5.678	61.191	1.002
Boise City-Nampa, ID	4.525	48.765	0.085
Boston-Cambridge-Quincy, MA-NH	2.681	28.891	0.464
Bridgeport-Stamford-Norwalk, CT	2.456	26.470	0.255
Buffalo-Niagara Falls, NY	4.040	43.534	0.490
Cape Coral-Fort Myers, FL	5.504	59.314	0.968
Charleston-North Charleston, SC	5.644	60.822	0.629
Charlotte-Gastonia-Concord, NC-SC	4.966	53.510	0.812
Chattanooga, TN-GA	5.803	62.531	1.061
Chicago-Naperville-Joliet, IL-IN-WI	2.192	23.618	0.313
Cincinnati-Middletown, OH-KY-IN	4.016	43.272	0.916
Cleveland-Elyria-Mentor, OH	2.584	27.845	0.589
Colorado Springs, CO	2.695	29.040	0.658
Columbia, SC	5.500	59.264	0.613
Columbus, OH	3.204	34.526	0.731
Dallas-Fort Worth-Arlington, TX	5.826	62.786	1.104
Dayton, OH	3.959	42.662	0.903
Denver-Aurora, CO	2.656	28.625	0.648
Des Moines, IA	3.021	32.549	0.818
Detroit-Warren-Livonia, MI	2.407	25.943	0.490
Durham, NC	5.297	57.086	0.867
El Paso, TX	1.912	20.599	0.362
Fresno, CA	2.743	29.557	0.242
Grand Rapids-Wyoming, MI	3.837	41.345	0.781
Greensboro-High Point, NC	4.995	53.829	0.817
Greenville, SC	4.910	52.910	0.547
Harrisburg-Carlisle, PA	4.355	46.931	0.723
Hartford-West Hartford-East Hartford, CT	2.767	29.813	0.287
Honolulu, HI	2.093	22.552	0.462
Houston-Baytown-Sugar Land, TX	5.265	56.737	0.997
Indianapolis, IN	4.365	47.040	1.141
Jackson, MS	5.120	55.177	0.828
Jacksonville, FL	5.588	60.214	0.983
Kansas City, MO-KS	4.600	49.571	1.081
Knoxville, TN	6.055	65.246	1.107
Lancaster, PA	4.108	44.266	0.682
Lansing-East Lansing, MI	3.825	41.215	0.779
Las Vegas-Paradise, NV	4.271	46.026	0.805
Lexington-Fayette, KY	5.281	56.904	1.341

Table A-2. (cont.)

Metro	MWh/person	Energy (MBtu/person)	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	4.806	51.784	0.855
Los Angeles-Long Beach-Santa Ana, CA	2.126	22.914	0.188
Louisville, KY-IN	4.801	51.732	1.219
Madison, WI	2.592	27.927	0.603
Memphis, TN-MS-AR	5.593	60.274	1.023
Miami-Fort Lauderdale-Miami Beach, FL	5.007	53.952	0.881
Milwaukee-Waukesha-West Allis, WI	2.667	28.744	0.621
Minneapolis-St. Paul-Bloomington, MN-WI	2.703	29.128	0.534
Nashville-Davidson--Murfreesboro, TN	6.236	67.201	1.141
New Haven-Milford, CT	2.427	26.157	0.252
New Orleans-Metairie-Kenner, LA	5.311	57.228	0.898
New York-Northern NJ-Long Island, NY-NJ-PA	1.640	17.676	0.199
Oklahoma City, OK	5.115	55.121	1.161
Omaha-Council Bluffs, NE-IA	3.689	39.750	0.673
Orlando, FL	5.015	54.037	0.882
Oxnard-Thousand Oaks-Ventura, CA	2.366	25.496	0.209
Palm Bay-Melbourne-Titusville, FL	5.400	58.185	0.950
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	3.018	32.519	0.501
Phoenix-Mesa-Scottsdale, AZ	4.334	46.704	0.601
Pittsburgh, PA	3.034	32.698	0.504
Portland-South Portland-Biddeford, ME	1.758	18.941	0.223
Portland-Vancouver-Beaverton, OR-WA	4.118	44.380	0.177
Poughkeepsie-Newburgh-Middletown, NY	4.036	43.488	0.489
Providence-New Bedford-Fall River, RI-MA	3.132	33.746	0.410
Raleigh-Cary, NC	5.180	55.825	0.848
Richmond, VA	5.049	54.412	0.857
Riverside-San Bernardino-Ontario, CA	2.388	25.734	0.211
Rochester, NY	3.201	34.498	0.388
Sacramento--Arden-Arcade--Roseville, CA	2.695	29.038	0.238
Salt Lake City, UT	3.574	38.509	0.876
San Antonio, TX	4.871	52.485	0.922
San Diego-Carlsbad-San Marcos, CA	2.162	23.298	0.191
San Francisco-Oakland-Fremont, CA	2.770	29.855	0.245
San Jose-Sunnyvale-Santa Clara, CA	3.165	34.107	0.280
Sarasota-Bradenton-Venice, FL	5.809	62.600	1.022
Scranton--Wilkes-Barre, PA	4.090	44.077	0.679
Seattle-Tacoma-Bellevue, WA	4.169	44.922	0.163
Springfield, MA	2.399	25.854	0.416
St. Louis, MO-IL	4.566	49.201	1.073
Stockton, CA	3.450	37.173	0.305
Syracuse, NY	4.184	45.082	0.507
Tampa-St. Petersburg-Clearwater, FL	5.868	63.231	1.032
Toledo, OH	4.155	44.771	0.948
Trenton-Ewing, NJ	2.077	22.385	0.213
Tucson, AZ	3.490	37.605	0.484
Tulsa, OK	5.153	55.531	1.170
Virginia Beach-Norfolk-Newport News, VA-NC	4.913	52.941	0.834
Washington-Arlington-Alexandria, DC-VA-MD-WV	4.294	46.277	1.371
Wichita, KS	4.108	44.273	0.914
Worcester, MA	2.336	25.172	0.405
Youngstown-Warren-Boardman, OH-PA	3.754	40.448	0.856
Average Top 100 Metros	3.501	37.727	0.590

Table A-3. Total Annual Energy Use and Carbon Emissions from Residential Electricity Consumption (Year 2005)

Metro	Residential Electricity Use (MWH)	Energy Use (Btu in billions)	Carbon (million metric tons)
Akron, OH	2,389,591	25,927	0.547
Albany-Schenectady-Troy, NY	2,880,316	31,251	0.323
Albuquerque, NM	1,940,227	21,051	0.493
Allentown-Bethlehem-Easton, PA-NJ	2,779,827	30,161	0.441
Atlanta-Sandy Springs-Marietta, GA	23,377,516	253,646	4.164
Augusta-Richmond County, GA-SC	2,660,949	28,871	0.474
Austin-Round Rock, TX	7,462,589	80,969	1.328
Bakersfield, CA	1,619,925	17,576	0.121
Baltimore-Towson, MD	15,591,329	169,166	2.691
Baton Rouge, LA	4,324,453	46,920	0.727
Birmingham-Hoover, AL	6,474,012	70,243	1.073
Boise City-Nampa, ID	2,328,010	25,259	0.078
Boston-Cambridge-Quincy, MA-NH	11,912,017	129,245	1.833
Bridgeport-Stamford-Norwalk, CT	2,917,636	31,656	0.274
Buffalo-Niagara Falls, NY	4,124,349	44,749	0.463
Cape Coral-Fort Myers, FL	3,056,388	33,162	0.493
Charleston-North Charleston, SC	3,561,210	38,639	0.387
Charlotte-Gastonia-Concord, NC-SC	8,068,177	87,540	1.287
Chattanooga, TN-GA	3,082,045	33,440	0.518
Chicago-Naperville-Joliet, IL-IN-WI	24,949,011	270,697	3.533
Cincinnati-Middletown, OH-KY-IN	11,458,560	124,325	2.624
Cleveland-Elyria-Mentor, OH	6,443,183	69,909	1.475
Colorado Springs, CO	1,620,139	17,579	0.364
Columbia, SC	3,970,075	43,075	0.432
Columbus, OH	6,139,557	66,614	1.406
Dallas-Fort Worth-Arlington, TX	34,226,733	371,360	6.089
Dayton, OH	3,513,378	38,120	0.805
Denver-Aurora, CO	6,570,019	71,285	1.475
Des Moines, IA	1,769,930	19,204	0.439
Detroit-Warren-Livonia, MI	9,759,039	105,886	1.722
Durham, NC	2,514,898	27,287	0.401
El Paso, TX	1,476,614	16,021	0.263
Fresno, CA	2,383,687	25,863	0.178
Grand Rapids-Wyoming, MI	2,121,471	23,018	0.374
Greensboro-High Point, NC	3,618,088	39,256	0.577
Greenville, SC	3,078,794	33,405	0.335
Harrisburg-Carlisle, PA	2,041,595	22,151	0.324
Hartford-West Hartford-East Hartford, CT	4,553,086	49,401	0.427
Honolulu, HI	2,096,109	22,743	0.448
Houston-Baytown-Sugar Land, TX	25,819,520	280,142	4.593
Indianapolis, IN	7,927,067	86,009	2.025
Jackson, MS	2,852,040	30,945	0.434
Jacksonville, FL	7,574,201	82,180	1.222
Kansas City, MO-KS	8,310,687	90,171	1.992
Knoxville, TN	4,165,582	45,197	0.700
Lancaster, PA	1,746,913	18,954	0.277
Lansing-East Lansing, MI	1,296,150	14,063	0.229
Las Vegas-Paradise, NV	7,327,997	79,509	1.290
Lexington-Fayette, KY	2,518,816	27,329	0.634

Table A-3. (cont.)

Metro	Residential Electricity Use (MWH)	Energy Use (Btu billions)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	3,429,145	37,206	0.516
Los Angeles-Long Beach-Santa Ana, CA	37,054,238	402,038	2.761
Louisville, KY-IN	6,330,286	68,684	1.595
Madison, WI	1,486,528	16,129	0.354
Memphis, TN-MS-AR	7,435,808	80,679	1.250
Miami-Fort Lauderdale-Miami Beach, FL	28,297,270	307,025	4.564
Milwaukee-Waukesha-West Allis, WI	4,385,103	47,578	1.044
Minneapolis-St. Paul-Bloomington, MN-WI	10,331,889	112,101	2.066
Nashville-Davidson--Murfreesboro, TN	9,719,743	105,459	1.634
New Haven-Milford, CT	2,632,978	28,568	0.247
New Orleans-Metairie-Kenner, LA	6,636,067	72,001	1.116
New York-Northern NJ-Long Island, NY-NJ-PA	37,758,223	409,677	4.236
Oklahoma City, OK	6,080,109	65,969	1.243
Omaha-Council Bluffs, NE-IA	3,210,119	34,830	0.614
Orlando, FL	10,081,609	109,385	1.626
Oxnard-Thousand Oaks-Ventura, CA	2,020,958	21,927	0.151
Palm Bay-Melbourne-Titusville, FL	2,680,743	29,086	0.432
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	22,674,290	246,016	3.594
Phoenix-Mesa-Scottsdale, AZ	16,018,372	173,799	2.212
Pittsburgh, PA	8,106,134	87,952	1.285
Portland-South Portland-Biddeford, ME	1,245,989	13,519	0.127
Portland-Vancouver-Beaverton, OR-WA	8,354,937	90,651	0.414
Poughkeepsie-Newburgh-Middletown, NY	1,860,654	20,188	0.209
Providence-New Bedford-Fall River, RI-MA	7,110,790	77,152	0.834
Raleigh-Cary, NC	5,123,720	55,592	0.817
Richmond, VA	7,100,791	77,044	1.170
Riverside-San Bernardino-Ontario, CA	9,670,391	104,924	0.720
Rochester, NY	3,546,781	38,483	0.398
Sacramento--Arden-Arcade--Roseville, CA	5,424,169	58,852	0.404
Salt Lake City, UT	2,695,748	29,249	0.692
San Antonio, TX	9,338,337	101,321	1.661
San Diego-Carlsbad-San Marcos, CA	6,201,913	67,291	0.462
San Francisco-Oakland-Fremont, CA	9,797,494	106,303	0.730
San Jose-Sunnyvale-Santa Clara, CA	4,495,721	48,779	0.335
Sarasota-Bradenton-Venice, FL	4,119,823	44,700	0.665
Scranton--Wilkes-Barre, PA	2,018,896	21,905	0.320
Seattle-Tacoma-Bellevue, WA	12,419,325	134,750	0.494
Springfield, MA	3,202,813	34,751	0.493
St. Louis, MO-IL	13,877,112	150,567	3.326
Stockton, CA	1,785,648	19,374	0.133
Syracuse, NY	2,261,621	24,539	0.254
Tampa-St. Petersburg-Clearwater, FL	15,775,013	171,159	2.545
Toledo, OH	2,162,230	23,460	0.495
Trenton-Ewing, NJ	1,061,574	11,518	0.101
Tucson, AZ	3,411,505	37,015	0.471
Tulsa, OK	4,936,741	53,564	1.010
Virginia Beach-Norfolk-Newport News, VA-NC	9,136,557	99,132	1.506
Washington-Arlington-Alexandria, DC-VA-MD-WV	30,021,265	325,731	8.460
Wichita, KS	2,438,641	26,459	0.546
Worcester, MA	2,179,199	23,644	0.335
Youngstown-Warren-Boardman, OH-PA	1,978,711	21,469	0.453
Total Top 100 Metros	735,517,225	7,980,362	117.922

Table A-4. Per capita Annual Energy Use and Carbon Emissions from Residential Electricity Consumption (Year 2005)

Metro	MWh/person	Energy (MBtu/person)	Carbon (metric tons/person)
Akron, OH	3.407	36.963	0.780
Albany-Schenectady-Troy, NY	3.399	36.878	0.381
Albuquerque, NM	2.433	26.396	0.618
Allentown-Bethlehem-Easton, PA-NJ	3.520	38.193	0.558
Atlanta-Sandy Springs-Marietta, GA	4.702	51.013	0.837
Augusta-Richmond County, GA-SC	5.138	55.752	0.915
Austin-Round Rock, TX	5.130	55.660	0.913
Bakersfield, CA	2.140	23.219	0.159
Baltimore-Towson, MD	5.881	63.810	1.015
Baton Rouge, LA	5.913	64.158	0.994
Birmingham-Hoover, AL	5.949	64.549	0.986
Boise City-Nampa, ID	4.270	46.335	1.091
Boston-Cambridge-Quincy, MA-NH	2.678	29.051	0.412
Bridgeport-Stamford-Norwalk, CT	3.238	35.131	0.304
Buffalo-Niagara Falls, NY	3.603	39.089	0.404
Cape Coral-Fort Myers, FL	5.616	60.937	0.906
Charleston-North Charleston, SC	6.018	65.292	0.654
Charlotte-Gastonia-Concord, NC-SC	5.303	57.536	0.846
Chattanooga, TN-GA	6.267	68.001	1.054
Chicago-Naperville-Joliet, IL-IN-WI	2.641	28.656	0.374
Cincinnati-Middletown, OH-KY-IN	5.480	59.458	1.255
Cleveland-Elyria-Mentor, OH	3.032	32.896	0.694
Colorado Springs, CO	2.761	29.961	0.620
Columbia, SC	5.746	62.341	0.625
Columbus, OH	3.597	39.026	0.824
Dallas-Fort Worth-Arlington, TX	5.878	63.774	1.046
Dayton, OH	4.176	45.314	0.956
Denver-Aurora, CO	2.782	30.183	0.625
Des Moines, IA	3.382	36.693	0.840
Detroit-Warren-Livonia, MI	2.179	23.639	0.385
Durham, NC	5.513	59.816	0.879
El Paso, TX	2.047	22.215	0.364
Fresno, CA	2.715	29.454	0.202
Grand Rapids-Wyoming, MI	2.755	29.887	0.486
Greensboro-High Point, NC	5.366	58.225	0.856
Greenville, SC	5.213	56.559	0.567
Harrisburg-Carlisle, PA	3.921	42.542	0.621
Hartford-West Hartford-East Hartford, CT	3.840	41.664	0.360
Honolulu, HI	2.317	25.140	0.495
Houston-Baytown-Sugar Land, TX	4.824	52.338	0.858
Indianapolis, IN	4.833	52.443	1.235
Jackson, MS	5.478	59.431	0.834
Jacksonville, FL	6.070	65.859	0.979
Kansas City, MO-KS	4.274	46.368	1.024
Knoxville, TN	6.351	68.907	1.068
Lancaster, PA	3.566	38.687	0.565
Lansing-East Lansing, MI	2.851	30.931	0.503
Las Vegas-Paradise, NV	4.287	46.514	0.755
Lexington-Fayette, KY	5.862	63.604	1.477

Table A-4. (cont.)

Metro	MWh/person	Energy (MBtu/person)	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	5.336	57.897	0.803
Los Angeles-Long Beach-Santa Ana, CA	2.865	31.084	0.213
Louisville, KY-IN	5.231	56.755	1.318
Madison, WI	2.768	30.036	0.659
Memphis, TN-MS-AR	5.917	64.202	0.995
Miami-Fort Lauderdale-Miami Beach, FL	5.216	56.598	0.841
Milwaukee-Waukesha-West Allis, WI	2.905	31.522	0.692
Minneapolis-St. Paul-Bloomington, MN-WI	3.289	35.689	0.658
Nashville-Davidson--Murfreesboro, TN	6.839	74.208	1.150
New Haven-Milford, CT	3.118	33.828	0.292
New Orleans-Metairie-Kenner, LA	5.051	54.804	0.849
New York-Northern NJ-Long Island, NY-NJ-PA	2.007	21.775	0.225
Oklahoma City, OK	5.264	57.117	1.077
Omaha-Council Bluffs, NE-IA	3.949	42.850	0.756
Orlando, FL	5.220	56.633	0.842
Oxnard-Thousand Oaks-Ventura, CA	2.538	27.535	0.189
Palm Bay-Melbourne-Titusville, FL	5.071	55.021	0.818
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	3.905	42.372	0.619
Phoenix-Mesa-Scottsdale, AZ	4.130	44.811	0.570
Pittsburgh, PA	3.404	36.929	0.539
Portland-South Portland-Biddeford, ME	2.429	26.353	0.248
Portland-Vancouver-Beaverton, OR-WA	3.985	43.238	0.198
Poughkeepsie-Newburgh-Middletown, NY	2.789	30.255	0.313
Providence-New Bedford-Fall River, RI-MA	4.391	47.641	0.515
Raleigh-Cary, NC	5.383	58.407	0.859
Richmond, VA	6.051	65.658	0.997
Riverside-San Bernardino-Ontario, CA	2.473	26.835	0.184
Rochester, NY	3.421	37.113	0.384
Sacramento--Arden-Arcade--Roseville, CA	2.657	28.825	0.198
Salt Lake City, UT	2.576	27.944	0.661
San Antonio, TX	4.946	53.664	0.880
San Diego-Carlsbad-San Marcos, CA	2.112	22.914	0.157
San Francisco-Oakland-Fremont, CA	2.356	25.566	0.176
San Jose-Sunnyvale-Santa Clara, CA	2.553	27.697	0.190
Sarasota-Bradenton-Venice, FL	6.136	66.580	0.990
Scranton--Wilkes-Barre, PA	3.667	39.788	0.581
Seattle-Tacoma-Bellevue, WA	3.871	42.006	0.154
Springfield, MA	4.665	50.620	0.718
St. Louis, MO-IL	4.987	54.114	1.195
Stockton, CA	2.686	29.143	0.200
Syracuse, NY	3.477	37.726	0.390
Tampa-St. Petersburg-Clearwater, FL	5.961	64.673	0.961
Toledo, OH	3.298	35.783	0.755
Trenton-Ewing, NJ	2.900	31.464	0.275
Tucson, AZ	3.688	40.016	0.509
Tulsa, OK	5.573	60.471	1.140
Virginia Beach-Norfolk-Newport News, VA-NC	5.566	60.389	0.917
Washington-Arlington-Alexandria, DC-VA-MD-WV	5.717	62.025	1.611
Wichita, KS	4.155	45.081	0.930
Worcester, MA	2.788	30.247	0.429
Youngstown-Warren-Boardman, OH-PA	3.348	36.329	0.767
Average Top 100 Metros	3.811	41.348	0.614

Table A-5. Total Annual Energy Use and Carbon Emissions from Residential Fuel Consumption (Year 2000)

Metro	Residential Fuel Use (billion Btu)	Carbon (million metric tons)
Akron, OH	25,208	0.366
Albany-Schenectady-Troy, NY	34,445	0.518
Albuquerque, NM	17,662	0.244
Allentown-Bethlehem-Easton, PA-NJ	26,276	0.416
Atlanta-Sandy Springs-Marietta, GA	84,018	1.156
Augusta-Richmond County, GA-SC	10,565	0.145
Austin-Round Rock, TX	13,956	0.199
Bakersfield, CA	10,017	0.138
Baltimore-Towson, MD	62,020	0.930
Baton Rouge, LA	9,652	0.135
Birmingham-Hoover, AL	6,415	0.089
Boise City-Nampa, ID	10,597	0.151
Boston-Cambridge-Quincy, MA-NH	164,945	2.748
Bridgeport-Stamford-Norwalk, CT	33,485	0.581
Buffalo-Niagara Falls, NY	46,893	0.709
Cape Coral-Fort Myers, FL	956	0.013
Charleston-North Charleston, SC	6,278	0.085
Charlotte-Gastonia-Concord, NC-SC	19,840	0.291
Chattanooga, TN-GA	7,765	0.107
Chicago-Naperville-Joliet, IL-IN-WI	328,579	4.711
Cincinnati-Middletown, OH-KY-IN	68,634	0.997
Cleveland-Elyria-Mentor, OH	75,895	1.102
Colorado Springs, CO	15,557	0.216
Columbia, SC	2,892	0.039
Columbus, OH	56,047	0.814
Dallas-Fort Worth-Arlington, TX	55,811	0.796
Dayton, OH	31,130	0.452
Denver-Aurora, CO	62,274	0.866
Des Moines, IA	15,506	0.224
Detroit-Warren-Livonia, MI	197,804	2.890
Durham, NC	6,250	0.092
El Paso, TX	6,604	0.094
Fresno, CA	11,611	0.160
Grand Rapids-Wyoming, MI	31,479	0.460
Greensboro-High Point, NC	10,119	0.148
Greenville, SC	2,565	0.035
Harrisburg-Carlisle, PA	18,202	0.288
Hartford-West Hartford-East Hartford, CT	45,421	0.789
Honolulu, HI	1,004	0.016
Houston-Baytown-Sugar Land, TX	49,018	0.699
Indianapolis, IN	48,004	0.695
Jackson, MS	7,495	0.106
Jacksonville, FL	2,223	0.030
Kansas City, MO-KS	47,227	0.665
Knoxville, TN	10,202	0.141
Lancaster, PA	15,848	0.251
Lansing-East Lansing, MI	19,313	0.282
Las Vegas-Paradise, NV	22,261	0.304
Lexington-Fayette, KY	8,306	0.118

Table A-5. (cont.)

Metro	Residential Fuel Use (billion Btu)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	12,222	0.175
Los Angeles-Long Beach-Santa Ana, CA	168,135	2.323
Louisville, KY-IN	24,321	0.345
Madison, WI	15,862	0.237
Memphis, TN-MS-AR	17,776	0.246
Miami-Fort Lauderdale-Miami Beach, FL	8,307	0.112
Milwaukee-Waukesha-West Allis, WI	46,734	0.699
Minneapolis-St. Paul-Bloomington, MN-WI	95,923	1.399
Nashville-Davidson--Murfreesboro, TN	19,920	0.276
New Haven-Milford, CT	32,233	0.562
New Orleans-Metairie-Kenner, LA	18,349	0.258
New York-Northern NJ-Long Island, NY-NJ-PA	515,708	8.350
Oklahoma City, OK	24,836	0.354
Omaha-Council Bluffs, NE-IA	21,856	0.308
Orlando, FL	3,337	0.045
Oxnard-Thousand Oaks-Ventura, CA	11,569	0.159
Palm Bay-Melbourne-Titusville, FL	1,082	0.015
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	191,791	3.041
Phoenix-Mesa-Scottsdale, AZ	27,469	0.336
Pittsburgh, PA	90,352	1.432
Portland-South Portland-Biddeford, ME	20,435	0.380
Portland-Vancouver-Beaverton, OR-WA	31,054	0.415
Poughkeepsie-Newburgh-Middletown, NY	21,706	0.323
Providence-New Bedford-Fall River, RI-MA	61,065	1.013
Raleigh-Cary, NC	11,861	0.174
Richmond, VA	23,124	0.349
Riverside-San Bernardino-Ontario, CA	48,773	0.670
Rochester, NY	39,919	0.594
Sacramento--Arden-Arcade--Roseville, CA	30,851	0.424
Salt Lake City, UT	28,159	0.392
San Antonio, TX	19,046	0.272
San Diego-Carlsbad-San Marcos, CA	42,197	0.582
San Francisco-Oakland-Fremont, CA	65,805	0.910
San Jose-Sunnyvale-Santa Clara, CA	25,753	0.355
Sarasota-Bradenton-Venice, FL	1,378	0.019
Scranton--Wilkes-Barre, PA	21,038	0.334
Seattle-Tacoma-Bellevue, WA	49,598	0.670
Springfield, MA	26,711	0.443
St. Louis, MO-IL	43,026	0.607
Stockton, CA	8,637	0.119
Syracuse, NY	24,880	0.371
Tampa-St. Petersburg-Clearwater, FL	5,232	0.070
Toledo, OH	23,477	0.341
Trenton-Ewing, NJ	12,122	0.186
Tucson, AZ	7,621	0.093
Tulsa, OK	19,429	0.277
Virginia Beach-Norfolk-Newport News, VA-NC	29,818	0.452
Washington-Arlington-Alexandria, DC-VA-MD-WV	122,732	1.748
Wichita, KS	19,002	0.284
Worcester, MA	29,316	0.487
Youngstown-Warren-Boardman, OH-PA	29,521	0.428
Total Top 100 Metros	4,155,342	61.955

Table A-6. Per Capita Annual Energy Use and Carbon Emissions from Residential Fuel Consumption (Year 2000)

Metro	MBtu/person	Carbon (metric tons/person)
Akron, OH	36.273	0.527
Albany-Schenectady-Troy, NY	41.708	0.627
Albuquerque, NM	24.206	0.335
Allentown-Bethlehem-Easton, PA-NJ	35.489	0.562
Atlanta-Sandy Springs-Marietta, GA	19.778	0.272
Augusta-Richmond County, GA-SC	21.143	0.291
Austin-Round Rock, TX	11.167	0.159
Bakersfield, CA	15.139	0.208
Baltimore-Towson, MD	24.293	0.364
Baton Rouge, LA	13.671	0.192
Birmingham-Hoover, AL	6.097	0.085
Boise City-Nampa, ID	22.798	0.325
Boston-Cambridge-Quincy, MA-NH	37.561	0.626
Bridgeport-Stamford-Norwalk, CT	37.940	0.659
Buffalo-Niagara Falls, NY	40.076	0.606
Cape Coral-Fort Myers, FL	2.168	0.029
Charleston-North Charleston, SC	11.435	0.156
Charlotte-Gastonia-Concord, NC-SC	14.913	0.218
Chattanooga, TN-GA	16.294	0.225
Chicago-Naperville-Joliet, IL-IN-WI	36.114	0.518
Cincinnati-Middletown, OH-KY-IN	34.153	0.496
Cleveland-Elyria-Mentor, OH	35.331	0.513
Colorado Springs, CO	28.943	0.403
Columbia, SC	4.468	0.061
Columbus, OH	34.754	0.505
Dallas-Fort Worth-Arlington, TX	10.813	0.154
Dayton, OH	36.704	0.533
Denver-Aurora, CO	28.861	0.401
Des Moines, IA	32.211	0.465
Detroit-Warren-Livonia, MI	44.425	0.649
Durham, NC	14.654	0.215
El Paso, TX	9.717	0.139
Fresno, CA	14.524	0.200
Grand Rapids-Wyoming, MI	42.511	0.621
Greensboro-High Point, NC	15.727	0.230
Greenville, SC	4.582	0.062
Harrisburg-Carlisle, PA	35.754	0.566
Hartford-West Hartford-East Hartford, CT	39.544	0.687
Honolulu, HI	1.146	0.018
Houston-Baytown-Sugar Land, TX	10.395	0.148
Indianapolis, IN	31.476	0.456
Jackson, MS	15.075	0.213
Jacksonville, FL	1.980	0.027
Kansas City, MO-KS	25.722	0.362
Knoxville, TN	16.560	0.229
Lancaster, PA	33.673	0.533
Lansing-East Lansing, MI	43.135	0.630
Las Vegas-Paradise, NV	16.181	0.221
Lexington-Fayette, KY	20.341	0.289

Table A-6. (cont.)

Metro	MBtu/person	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	20.019	0.287
Los Angeles-Long Beach-Santa Ana, CA	13.597	0.188
Louisville, KY-IN	20.931	0.297
Madison, WI	31.612	0.473
Memphis, TN-MS-AR	14.749	0.204
Miami-Fort Lauderdale-Miami Beach, FL	1.659	0.022
Milwaukee-Waukesha-West Allis, WI	31.141	0.466
Minneapolis-St. Paul-Bloomington, MN-WI	32.310	0.471
Nashville-Davidson--Murfreesboro, TN	15.185	0.210
New Haven-Milford, CT	39.117	0.682
New Orleans-Metairie-Kenner, LA	13.938	0.196
New York-Northern NJ-Long Island, NY-NJ-PA	28.145	0.456
Oklahoma City, OK	22.673	0.323
Omaha-Council Bluffs, NE-IA	28.494	0.402
Orlando, FL	2.029	0.027
Oxnard-Thousand Oaks-Ventura, CA	15.360	0.211
Palm Bay-Melbourne-Titusville, FL	2.272	0.031
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	33.724	0.535
Phoenix-Mesa-Scottsdale, AZ	8.447	0.103
Pittsburgh, PA	37.165	0.589
Portland-South Portland-Biddeford, ME	41.911	0.780
Portland-Vancouver-Beaverton, OR-WA	16.108	0.215
Poughkeepsie-Newburgh-Middletown, NY	34.925	0.520
Providence-New Bedford-Fall River, RI-MA	38.576	0.640
Raleigh-Cary, NC	14.880	0.218
Richmond, VA	21.080	0.318
Riverside-San Bernardino-Ontario, CA	14.985	0.206
Rochester, NY	38.464	0.573
Sacramento--Arden-Arcade--Roseville, CA	17.169	0.236
Salt Lake City, UT	29.064	0.405
San Antonio, TX	11.127	0.159
San Diego-Carlsbad-San Marcos, CA	14.996	0.207
San Francisco-Oakland-Fremont, CA	15.958	0.221
San Jose-Sunnyvale-Santa Clara, CA	14.836	0.204
Sarasota-Bradenton-Venice, FL	2.335	0.031
Scranton--Wilkes-Barre, PA	37.526	0.596
Seattle-Tacoma-Bellevue, WA	16.294	0.220
Springfield, MA	39.281	0.651
St. Louis, MO-IL	15.943	0.225
Stockton, CA	15.325	0.211
Syracuse, NY	38.267	0.570
Tampa-St. Petersburg-Clearwater, FL	2.184	0.029
Toledo, OH	35.616	0.517
Trenton-Ewing, NJ	34.559	0.529
Tucson, AZ	9.032	0.111
Tulsa, OK	22.604	0.322
Virginia Beach-Norfolk-Newport News, VA-NC	18.916	0.286
Washington-Arlington-Alexandria, DC-VA-MD-WV	25.590	0.364
Wichita, KS	33.269	0.496
Worcester, MA	39.038	0.649
Youngstown-Warren-Boardman, OH-PA	48.961	0.710
Average Top 100 Metros	22.885	0.341

Table A-7. Total Annual Energy Use and Carbon Emissions from Residential Fuel Consumption (Year 2005)

Metro	Residential Fuel Use (billion Btu)	Carbon (million metric tons)
Akron, OH	23,789	0.341
Albany-Schenectady-Troy, NY	32,254	0.495
Albuquerque, NM	17,210	0.244
Allentown-Bethlehem-Easton, PA-NJ	23,443	0.371
Atlanta-Sandy Springs-Marietta, GA	75,965	1.051
Augusta-Richmond County, GA-SC	8,608	0.119
Austin-Round Rock, TX	14,099	0.199
Bakersfield, CA	10,497	0.144
Baltimore-Towson, MD	60,221	0.910
Baton Rouge, LA	7,768	0.106
Birmingham-Hoover, AL	11,785	0.173
Boise City-Nampa, ID	11,454	0.166
Boston-Cambridge-Quincy, MA-NH	156,914	2.600
Bridgeport-Stamford-Norwalk, CT	35,298	0.617
Buffalo-Niagara Falls, NY	45,280	0.698
Cape Coral-Fort Myers, FL	1,024	0.014
Charleston-North Charleston, SC	5,908	0.082
Charlotte-Gastonia-Concord, NC-SC	19,362	0.285
Chattanooga, TN-GA	7,098	0.098
Chicago-Naperville-Joliet, IL-IN-WI	305,790	4.336
Cincinnati-Middletown, OH-KY-IN	65,874	0.943
Cleveland-Elyria-Mentor, OH	69,432	0.995
Colorado Springs, CO	16,714	0.238
Columbia, SC	6,969	0.096
Columbus, OH	56,666	0.812
Dallas-Fort Worth-Arlington, TX	54,182	0.763
Dayton, OH	29,105	0.417
Denver-Aurora, CO	66,471	0.945
Des Moines, IA	14,643	0.208
Detroit-Warren-Livonia, MI	191,392	2.765
Durham, NC	5,817	0.086
El Paso, TX	6,108	0.086
Fresno, CA	11,951	0.165
Grand Rapids-Wyoming, MI	31,256	0.452
Greensboro-High Point, NC	9,094	0.134
Greenville, SC	6,086	0.084
Harrisburg-Carlisle, PA	17,383	0.275
Hartford-West Hartford-East Hartford, CT	48,343	0.845
Honolulu, HI	768	0.012
Houston-Baytown-Sugar Land, TX	47,594	0.670
Indianapolis, IN	45,814	0.651
Jackson, MS	5,947	0.081
Jacksonville, FL	2,192	0.030
Kansas City, MO-KS	44,199	0.612
Knoxville, TN	9,513	0.131
Lancaster, PA	15,385	0.243
Lansing-East Lansing, MI	18,945	0.274
Las Vegas-Paradise, NV	27,417	0.388
Lexington-Fayette, KY	7,271	0.102

Table A-7. (cont.)

Metro	Residential Fuel Use (billion Btu)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	9,498	0.133
Los Angeles-Long Beach-Santa Ana, CA	166,623	2.302
Louisville, KY-IN	18,484	0.260
Madison, WI	16,118	0.237
Memphis, TN-MS-AR	16,729	0.230
Miami-Fort Lauderdale-Miami Beach, FL	7,885	0.108
Milwaukee-Waukesha-West Allis, WI	44,416	0.655
Minneapolis-St. Paul-Bloomington, MN-WI	94,923	1.371
Nashville-Davidson--Murfreesboro, TN	19,223	0.265
New Haven-Milford, CT	33,812	0.593
New Orleans-Metairie-Kenner, LA	14,330	0.197
New York-Northern NJ-Long Island, NY-NJ-PA	515,972	8.372
Oklahoma City, OK	23,035	0.325
Omaha-Council Bluffs, NE-IA	20,511	0.287
Orlando, FL	3,450	0.047
Oxnard-Thousand Oaks-Ventura, CA	11,864	0.163
Palm Bay-Melbourne-Titusville, FL	1,059	0.015
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	181,751	2.876
Phoenix-Mesa-Scottsdale, AZ	26,272	0.339
Pittsburgh, PA	83,142	1.315
Portland-South Portland-Biddeford, ME	24,726	0.466
Portland-Vancouver-Beaverton, OR-WA	34,415	0.410
Poughkeepsie-Newburgh-Middletown, NY	22,364	0.341
Providence-New Bedford-Fall River, RI-MA	65,868	1.109
Raleigh-Cary, NC	11,789	0.173
Richmond, VA	23,338	0.357
Riverside-San Bernardino-Ontario, CA	53,396	0.734
Rochester, NY	39,078	0.595
Sacramento--Arden-Arcade--Roseville, CA	33,327	0.458
Salt Lake City, UT	28,377	0.403
San Antonio, TX	18,160	0.256
San Diego-Carlsbad-San Marcos, CA	43,067	0.594
San Francisco-Oakland-Fremont, CA	64,530	0.892
San Jose-Sunnyvale-Santa Clara, CA	25,458	0.351
Sarasota-Bradenton-Venice, FL	1,360	0.019
Scranton--Wilkes-Barre, PA	19,261	0.305
Seattle-Tacoma-Bellevue, WA	52,849	0.647
Springfield, MA	25,553	0.421
St. Louis, MO-IL	63,058	0.874
Stockton, CA	9,355	0.129
Syracuse, NY	24,394	0.372
Tampa-St. Petersburg-Clearwater, FL	5,021	0.069
Toledo, OH	21,963	0.314
Trenton-Ewing, NJ	12,288	0.186
Tucson, AZ	6,930	0.089
Tulsa, OK	17,822	0.252
Virginia Beach-Norfolk-Newport News, VA-NC	29,683	0.455
Washington-Arlington-Alexandria, DC-VA-MD-WV	124,771	1.820
Wichita, KS	16,405	0.228
Worcester, MA	28,827	0.476
Youngstown-Warren-Boardman, OH-PA	17,856	0.255
Total Top 100 Metros	4,080,683	60.688

Table A-8. Per Capita Annual Energy Use and Carbon Emissions from Residential Fuel Consumption (Year 2005)

Metro	MBtu/person	Carbon (metric tons/person)
Akron, OH	33.914	0.485
Albany-Schenectady-Troy, NY	38.062	0.584
Albuquerque, NM	21.579	0.306
Allentown-Bethlehem-Easton, PA-NJ	29.686	0.469
Atlanta-Sandy Springs-Marietta, GA	15.278	0.211
Augusta-Richmond County, GA-SC	16.623	0.230
Austin-Round Rock, TX	9.692	0.137
Bakersfield, CA	13.867	0.191
Baltimore-Towson, MD	22.716	0.343
Baton Rouge, LA	10.622	0.145
Birmingham-Hoover, AL	10.830	0.159
Boise City-Nampa, ID	21.011	0.304
Boston-Cambridge-Quincy, MA-NH	35.270	0.584
Bridgeport-Stamford-Norwalk, CT	39.173	0.684
Buffalo-Niagara Falls, NY	39.553	0.609
Cape Coral-Fort Myers, FL	1.882	0.026
Charleston-North Charleston, SC	9.984	0.138
Charlotte-Gastonia-Concord, NC-SC	12.726	0.187
Chattanooga, TN-GA	14.435	0.199
Chicago-Naperville-Joliet, IL-IN-WI	32.370	0.459
Cincinnati-Middletown, OH-KY-IN	31.504	0.451
Cleveland-Elyria-Mentor, OH	32.672	0.468
Colorado Springs, CO	28.487	0.405
Columbia, SC	10.086	0.139
Columbus, OH	33.198	0.476
Dallas-Fort Worth-Arlington, TX	9.305	0.131
Dayton, OH	34.597	0.495
Denver-Aurora, CO	28.145	0.400
Des Moines, IA	27.978	0.397
Detroit-Warren-Livonia, MI	42.729	0.617
Durham, NC	12.752	0.188
El Paso, TX	8.469	0.119
Fresno, CA	13.610	0.187
Grand Rapids-Wyoming, MI	40.583	0.586
Greensboro-High Point, NC	13.489	0.198
Greenville, SC	10.304	0.142
Harrisburg-Carlisle, PA	33.384	0.528
Hartford-West Hartford-East Hartford, CT	40.771	0.712
Honolulu, HI	0.849	0.014
Houston-Baytown-Sugar Land, TX	8.892	0.125
Indianapolis, IN	27.935	0.397
Jackson, MS	11.423	0.156
Jacksonville, FL	1.757	0.024
Kansas City, MO-KS	22.728	0.315
Knoxville, TN	14.503	0.200
Lancaster, PA	31.401	0.496
Lansing-East Lansing, MI	41.667	0.602
Las Vegas-Paradise, NV	16.039	0.227
Lexington-Fayette, KY	16.922	0.238

Table A-8. (cont.)

Metro	MBtu/person	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	14.779	0.207
Los Angeles-Long Beach-Santa Ana, CA	12.883	0.178
Louisville, KY-IN	15.274	0.215
Madison, WI	30.016	0.442
Memphis, TN-MS-AR	13.312	0.183
Miami-Fort Lauderdale-Miami Beach, FL	1.454	0.020
Milwaukee-Waukesha-West Allis, WI	29.427	0.434
Minneapolis-St. Paul-Bloomington, MN-WI	30.220	0.436
Nashville-Davidson--Murfreesboro, TN	13.527	0.186
New Haven-Milford, CT	40.038	0.702
New Orleans-Metairie-Kenner, LA	10.908	0.150
New York-Northern NJ-Long Island, NY-NJ-PA	27.425	0.445
Oklahoma City, OK	19.944	0.282
Omaha-Council Bluffs, NE-IA	25.234	0.354
Orlando, FL	1.786	0.025
Oxnard-Thousand Oaks-Ventura, CA	14.898	0.205
Palm Bay-Melbourne-Titusville, FL	2.004	0.027
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	31.304	0.495
Phoenix-Mesa-Scottsdale, AZ	6.774	0.087
Pittsburgh, PA	34.909	0.552
Portland-South Portland-Biddeford, ME	48.200	0.908
Portland-Vancouver-Beaverton, OR-WA	16.415	0.196
Poughkeepsie-Newburgh-Middletown, NY	33.516	0.511
Providence-New Bedford-Fall River, RI-MA	40.674	0.685
Raleigh-Cary, NC	12.386	0.182
Richmond, VA	19.889	0.304
Riverside-San Bernardino-Ontario, CA	13.657	0.188
Rochester, NY	37.688	0.574
Sacramento--Arden-Arcade--Roseville, CA	16.323	0.225
Salt Lake City, UT	27.112	0.385
San Antonio, TX	9.618	0.135
San Diego-Carlsbad-San Marcos, CA	14.665	0.202
San Francisco-Oakland-Fremont, CA	15.519	0.215
San Jose-Sunnyvale-Santa Clara, CA	14.455	0.199
Sarasota-Bradenton-Venice, FL	2.025	0.028
Scranton--Wilkes-Barre, PA	34.986	0.554
Seattle-Tacoma-Bellevue, WA	16.475	0.202
Springfield, MA	37.223	0.614
St. Louis, MO-IL	22.663	0.314
Stockton, CA	14.071	0.193
Syracuse, NY	37.504	0.571
Tampa-St. Petersburg-Clearwater, FL	1.897	0.026
Toledo, OH	33.499	0.480
Trenton-Ewing, NJ	33.568	0.508
Tucson, AZ	7.491	0.097
Tulsa, OK	20.120	0.284
Virginia Beach-Norfolk-Newport News, VA-NC	18.083	0.277
Washington-Arlington-Alexandria, DC-VA-MD-WV	23.759	0.347
Wichita, KS	27.950	0.389
Worcester, MA	36.877	0.609
Youngstown-Warren-Boardman, OH-PA	30.215	0.432
Average Top 100 Metros	21.143	0.314

Table A-9. Total Annual Energy Use and Carbon Emissions from Residential Electricity and Fuel Consumption (Year 2000)

Metro	Residential Electricity & Fuel Use (billion Btu)	Carbon (million metric tons)
Akron, OH	46,907	0.825
Albany-Schenectady-Troy, NY	73,380	0.956
Albuquerque, NM	35,038	0.663
Allentown-Bethlehem-Easton, PA-NJ	58,332	0.910
Atlanta-Sandy Springs-Marietta, GA	290,565	4.600
Augusta-Richmond County, GA-SC	36,699	0.581
Austin-Round Rock, TX	58,616	0.984
Bakersfield, CA	28,172	0.287
Baltimore-Towson, MD	183,188	2.856
Baton Rouge, LA	52,924	0.814
Birmingham-Hoover, AL	70,803	1.144
Boise City-Nampa, ID	33,265	0.191
Boston-Cambridge-Quincy, MA-NH	291,813	4.788
Bridgeport-Stamford-Norwalk, CT	56,846	0.806
Buffalo-Niagara Falls, NY	97,832	1.281
Cape Coral-Fort Myers, FL	27,107	0.440
Charleston-North Charleston, SC	39,671	0.431
Charlotte-Gastonia-Concord, NC-SC	91,033	1.371
Chattanooga, TN-GA	37,563	0.613
Chicago-Naperville-Joliet, IL-IN-WI	543,467	7.555
Cincinnati-Middletown, OH-KY-IN	155,596	2.838
Cleveland-Elyria-Mentor, OH	135,710	2.369
Colorado Springs, CO	31,165	0.570
Columbia, SC	41,245	0.436
Columbus, OH	111,727	1.993
Dallas-Fort Worth-Arlington, TX	379,883	6.492
Dayton, OH	67,314	1.218
Denver-Aurora, CO	124,039	2.265
Des Moines, IA	31,175	0.618
Detroit-Warren-Livonia, MI	313,316	5.072
Durham, NC	30,596	0.461
El Paso, TX	20,604	0.340
Fresno, CA	35,239	0.354
Grand Rapids-Wyoming, MI	62,094	1.038
Greensboro-High Point, NC	44,754	0.674
Greenville, SC	32,192	0.341
Harrisburg-Carlisle, PA	42,093	0.657
Hartford-West Hartford-East Hartford, CT	79,664	1.118
Honolulu, HI	20,763	0.421
Houston-Baytown-Sugar Land, TX	316,557	5.402
Indianapolis, IN	119,744	2.436
Jackson, MS	34,929	0.518
Jacksonville, FL	69,828	1.133
Kansas City, MO-KS	138,241	2.648
Knoxville, TN	50,399	0.823
Lancaster, PA	36,683	0.572
Lansing-East Lansing, MI	37,766	0.631
Las Vegas-Paradise, NV	85,582	1.412
Lexington-Fayette, KY	31,541	0.665

Table A-9. (cont.)

Metro	Residential Electricity & Fuel Use (billion Btu)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	43,837	0.697
Los Angeles-Long Beach-Santa Ana, CA	451,478	4.647
Louisville, KY-IN	84,432	1.761
Madison, WI	29,875	0.540
Memphis, TN-MS-AR	90,418	1.479
Miami-Fort Lauderdale-Miami Beach, FL	278,473	4.522
Milwaukee-Waukesha-West Allis, WI	89,871	1.631
Minneapolis-St. Paul-Bloomington, MN-WI	182,400	2.985
Nashville-Davidson--Murfreesboro, TN	108,073	1.772
New Haven-Milford, CT	53,787	0.769
New Orleans-Metairie-Kenner, LA	93,690	1.439
New York-Northern NJ-Long Island, NY-NJ-PA	839,593	11.993
Oklahoma City, OK	85,217	1.626
Omaha-Council Bluffs, NE-IA	52,346	0.825
Orlando, FL	92,203	1.495
Oxnard-Thousand Oaks-Ventura, CA	30,772	0.317
Palm Bay-Melbourne-Titusville, FL	28,792	0.467
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	376,730	5.892
Phoenix-Mesa-Scottsdale, AZ	179,346	2.291
Pittsburgh, PA	169,844	2.657
Portland-South Portland-Biddeford, ME	29,670	0.489
Portland-Vancouver-Beaverton, OR-WA	116,613	0.756
Poughkeepsie-Newburgh-Middletown, NY	48,735	0.627
Providence-New Bedford-Fall River, RI-MA	114,485	1.662
Raleigh-Cary, NC	56,357	0.849
Richmond, VA	82,811	1.288
Riverside-San Bernardino-Ontario, CA	132,532	1.357
Rochester, NY	75,722	0.997
Sacramento--Arden-Arcade--Roseville, CA	83,028	0.852
Salt Lake City, UT	65,469	1.241
San Antonio, TX	108,884	1.851
San Diego-Carlsbad-San Marcos, CA	107,754	1.120
San Francisco-Oakland-Fremont, CA	188,918	1.920
San Jose-Sunnyvale-Santa Clara, CA	84,956	0.841
Sarasota-Bradenton-Venice, FL	38,309	0.621
Scranton--Wilkes-Barre, PA	45,749	0.715
Seattle-Tacoma-Bellevue, WA	186,336	1.167
Springfield, MA	44,293	0.725
St. Louis, MO-IL	175,804	3.501
Stockton, CA	29,588	0.291
Syracuse, NY	54,190	0.700
Tampa-St. Petersburg-Clearwater, FL	156,732	2.543
Toledo, OH	52,990	0.966
Trenton-Ewing, NJ	19,974	0.260
Tucson, AZ	39,350	0.502
Tulsa, OK	67,159	1.282
Virginia Beach-Norfolk-Newport News, VA-NC	113,272	1.766
Washington-Arlington-Alexandria, DC-VA-MD-WV	344,687	8.322
Wichita, KS	44,289	0.805
Worcester, MA	48,219	0.791
Youngstown-Warren-Boardman, OH-PA	53,910	0.945
Total Top 100 Metros	11,005,618	169.167

Table A-10. Per Capita Annual Energy Use and Carbon Emissions from Residential Electricity and Fuel Consumption (Year 2000)

Metro	MBtu/person	Carbon (metric tons/person)
Akron, OH	67.496	1.187
Albany-Schenectady-Troy, NY	88.851	1.158
Albuquerque, NM	48.020	0.908
Allentown-Bethlehem-Easton, PA-NJ	78.785	1.230
Atlanta-Sandy Springs-Marietta, GA	68.401	1.083
Augusta-Richmond County, GA-SC	73.444	1.163
Austin-Round Rock, TX	46.902	0.787
Bakersfield, CA	42.578	0.433
Baltimore-Towson, MD	71.754	1.119
Baton Rouge, LA	74.965	1.153
Birmingham-Hoover, AL	67.288	1.087
Boise City-Nampa, ID	71.562	0.410
Boston-Cambridge-Quincy, MA-NH	66.452	1.090
Bridgeport-Stamford-Norwalk, CT	64.410	0.913
Buffalo-Niagara Falls, NY	83.609	1.095
Cape Coral-Fort Myers, FL	61.482	0.997
Charleston-North Charleston, SC	72.256	0.784
Charlotte-Gastonia-Concord, NC-SC	68.422	1.031
Chattanooga, TN-GA	78.825	1.287
Chicago-Naperville-Joliet, IL-IN-WI	59.733	0.830
Cincinnati-Middletown, OH-KY-IN	77.425	1.412
Cleveland-Elyria-Mentor, OH	63.175	1.103
Colorado Springs, CO	57.983	1.060
Columbia, SC	63.733	0.673
Columbus, OH	69.280	1.236
Dallas-Fort Worth-Arlington, TX	73.599	1.258
Dayton, OH	79.366	1.436
Denver-Aurora, CO	57.485	1.050
Des Moines, IA	64.760	1.283
Detroit-Warren-Livonia, MI	70.368	1.139
Durham, NC	71.739	1.082
El Paso, TX	30.317	0.501
Fresno, CA	44.081	0.442
Grand Rapids-Wyoming, MI	83.856	1.402
Greensboro-High Point, NC	69.556	1.048
Greenville, SC	57.491	0.609
Harrisburg-Carlisle, PA	82.685	1.290
Hartford-West Hartford-East Hartford, CT	69.357	0.973
Honolulu, HI	23.698	0.481
Houston-Baytown-Sugar Land, TX	67.132	1.146
Indianapolis, IN	78.515	1.597
Jackson, MS	70.253	1.041
Jacksonville, FL	62.194	1.009
Kansas City, MO-KS	75.293	1.442
Knoxville, TN	81.806	1.336
Lancaster, PA	77.939	1.216
Lansing-East Lansing, MI	84.350	1.409
Las Vegas-Paradise, NV	62.207	1.026
Lexington-Fayette, KY	77.245	1.629

Table A-10. (cont.)

Metro	MBtu/person	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	71.803	1.142
Los Angeles-Long Beach-Santa Ana, CA	36.511	0.376
Louisville, KY-IN	72.663	1.515
Madison, WI	59.539	1.076
Memphis, TN-MS-AR	75.023	1.227
Miami-Fort Lauderdale-Miami Beach, FL	55.611	0.903
Milwaukee-Waukesha-West Allis, WI	59.885	1.087
Minneapolis-St. Paul-Bloomington, MN-WI	61.439	1.005
Nashville-Davidson--Murfreesboro, TN	82.386	1.351
New Haven-Milford, CT	65.275	0.933
New Orleans-Metairie-Kenner, LA	71.166	1.093
New York-Northern NJ-Long Island, NY-NJ-PA	45.822	0.655
Oklahoma City, OK	77.794	1.484
Omaha-Council Bluffs, NE-IA	68.244	1.075
Orlando, FL	56.065	0.909
Oxnard-Thousand Oaks-Ventura, CA	40.856	0.420
Palm Bay-Melbourne-Titusville, FL	60.457	0.980
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	66.242	1.036
Phoenix-Mesa-Scottsdale, AZ	55.152	0.704
Pittsburgh, PA	69.864	1.093
Portland-South Portland-Biddeford, ME	60.852	1.003
Portland-Vancouver-Beaverton, OR-WA	60.488	0.392
Poughkeepsie-Newburgh-Middletown, NY	78.413	1.009
Providence-New Bedford-Fall River, RI-MA	72.322	1.050
Raleigh-Cary, NC	70.705	1.066
Richmond, VA	75.491	1.175
Riverside-San Bernardino-Ontario, CA	40.719	0.417
Rochester, NY	72.962	0.961
Sacramento--Arden-Arcade--Roseville, CA	46.207	0.474
Salt Lake City, UT	67.574	1.281
San Antonio, TX	63.611	1.081
San Diego-Carlsbad-San Marcos, CA	38.294	0.398
San Francisco-Oakland-Fremont, CA	45.812	0.466
San Jose-Sunnyvale-Santa Clara, CA	48.943	0.484
Sarasota-Bradenton-Venice, FL	64.935	1.053
Scranton--Wilkes-Barre, PA	81.603	1.275
Seattle-Tacoma-Bellevue, WA	61.217	0.383
Springfield, MA	65.135	1.067
St. Louis, MO-IL	65.144	1.297
Stockton, CA	52.499	0.516
Syracuse, NY	83.350	1.077
Tampa-St. Petersburg-Clearwater, FL	65.414	1.062
Toledo, OH	80.387	1.465
Trenton-Ewing, NJ	56.944	0.742
Tucson, AZ	46.637	0.595
Tulsa, OK	78.135	1.492
Virginia Beach-Norfolk-Newport News, VA-NC	71.856	1.120
Washington-Arlington-Alexandria, DC-VA-MD-WV	71.867	1.735
Wichita, KS	77.542	1.410
Worcester, MA	64.210	1.053
Youngstown-Warren-Boardman, OH-PA	89.409	1.567
Average Top 100 Metros	60.612	0.932

Table A-11. Total Annual Energy Use and Carbon Emissions from Residential Electricity and Fuel Consumption (Year 2005)

Metro	Residential Electricity & Fuel Use (billion Btu)	Carbon (million metric tons)
Akron, OH	49,716	0.888
Albany-Schenectady-Troy, NY	63,506	0.818
Albuquerque, NM	38,261	0.737
Allentown-Bethlehem-Easton, PA-NJ	53,604	0.811
Atlanta-Sandy Springs-Marietta, GA	329,611	5.214
Augusta-Richmond County, GA-SC	37,480	0.593
Austin-Round Rock, TX	95,068	1.526
Bakersfield, CA	28,073	0.265
Baltimore-Towson, MD	229,387	3.601
Baton Rouge, LA	54,688	0.833
Birmingham-Hoover, AL	82,028	1.246
Boise City-Nampa, ID	36,713	0.244
Boston-Cambridge-Quincy, MA-NH	286,159	4.433
Bridgeport-Stamford-Norwalk, CT	66,955	0.890
Buffalo-Niagara Falls, NY	90,030	1.160
Cape Coral-Fort Myers, FL	34,186	0.507
Charleston-North Charleston, SC	44,547	0.469
Charlotte-Gastonia-Concord, NC-SC	106,902	1.571
Chattanooga, TN-GA	40,539	0.616
Chicago-Naperville-Joliet, IL-IN-WI	576,486	7.868
Cincinnati-Middletown, OH-KY-IN	190,200	3.567
Cleveland-Elyria-Mentor, OH	139,340	2.471
Colorado Springs, CO	34,292	0.601
Columbia, SC	50,044	0.528
Columbus, OH	123,281	2.218
Dallas-Fort Worth-Arlington, TX	425,542	6.852
Dayton, OH	67,225	1.221
Denver-Aurora, CO	137,756	2.420
Des Moines, IA	33,847	0.647
Detroit-Warren-Livonia, MI	297,278	4.487
Durham, NC	33,104	0.487
El Paso, TX	22,129	0.349
Fresno, CA	37,814	0.342
Grand Rapids-Wyoming, MI	54,274	0.826
Greensboro-High Point, NC	48,351	0.711
Greenville, SC	39,491	0.419
Harrisburg-Carlisle, PA	39,534	0.598
Hartford-West Hartford-East Hartford, CT	97,744	1.272
Honolulu, HI	23,511	0.460
Houston-Baytown-Sugar Land, TX	327,736	5.264
Indianapolis, IN	131,823	2.677
Jackson, MS	36,892	0.515
Jacksonville, FL	84,372	1.252
Kansas City, MO-KS	134,369	2.604
Knoxville, TN	54,709	0.831
Lancaster, PA	34,339	0.520
Lansing-East Lansing, MI	33,008	0.502
Las Vegas-Paradise, NV	106,926	1.677
Lexington-Fayette, KY	34,600	0.737

Table A-11. (cont.)

Metro	Residential Electricity & Fuel Use (billion Btu)	Carbon (million metric tons)
Little Rock-North Little Rock, AR	46,704	0.649
Los Angeles-Long Beach-Santa Ana, CA	568,662	5.063
Louisville, KY-IN	87,167	1.854
Madison, WI	32,247	0.591
Memphis, TN-MS-AR	97,407	1.480
Miami-Fort Lauderdale-Miami Beach, FL	314,911	4.673
Milwaukee-Waukesha-West Allis, WI	91,995	1.699
Minneapolis-St. Paul-Bloomington, MN-WI	207,024	3.437
Nashville-Davidson--Murfreesboro, TN	124,682	1.899
New Haven-Milford, CT	62,380	0.840
New Orleans-Metairie-Kenner, LA	86,332	1.313
New York-Northern NJ-Long Island, NY-NJ-PA	925,649	12.608
Oklahoma City, OK	89,004	1.569
Omaha-Council Bluffs, NE-IA	55,341	0.902
Orlando, FL	112,835	1.673
Oxnard-Thousand Oaks-Ventura, CA	33,791	0.314
Palm Bay-Melbourne-Titusville, FL	30,145	0.447
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	427,767	6.470
Phoenix-Mesa-Scottsdale, AZ	200,072	2.551
Pittsburgh, PA	171,094	2.599
Portland-South Portland-Biddeford, ME	38,245	0.593
Portland-Vancouver-Beaverton, OR-WA	125,066	0.824
Poughkeepsie-Newburgh-Middletown, NY	42,552	0.550
Providence-New Bedford-Fall River, RI-MA	143,020	1.943
Raleigh-Cary, NC	67,382	0.991
Richmond, VA	100,381	1.527
Riverside-San Bernardino-Ontario, CA	158,320	1.454
Rochester, NY	77,560	0.993
Sacramento--Arden-Arcade--Roseville, CA	92,179	0.863
Salt Lake City, UT	57,626	1.095
San Antonio, TX	119,481	1.917
San Diego-Carlsbad-San Marcos, CA	110,358	1.056
San Francisco-Oakland-Fremont, CA	170,833	1.622
San Jose-Sunnyvale-Santa Clara, CA	74,237	0.686
Sarasota-Bradenton-Venice, FL	46,060	0.683
Scranton--Wilkes-Barre, PA	41,166	0.625
Seattle-Tacoma-Bellevue, WA	187,599	1.141
Springfield, MA	60,304	0.914
St. Louis, MO-IL	213,624	4.200
Stockton, CA	28,729	0.262
Syracuse, NY	48,932	0.625
Tampa-St. Petersburg-Clearwater, FL	176,180	2.613
Toledo, OH	45,423	0.810
Trenton-Ewing, NJ	23,806	0.287
Tucson, AZ	43,944	0.561
Tulsa, OK	71,386	1.261
Virginia Beach-Norfolk-Newport News, VA-NC	128,815	1.961
Washington-Arlington-Alexandria, DC-VA-MD-WV	450,502	10.280
Wichita, KS	42,864	0.774
Worcester, MA	52,471	0.812
Youngstown-Warren-Boardman, OH-PA	39,325	0.709
Total Top 100 Metros	12,061,045	178.610

Table A-12. Per Capita Annual Energy Use and Carbon Emissions from Residential Electricity and Fuel Consumption (Year 2005)

Metro	MBtu/person	Carbon (metric tons/person)
Akron, OH	70.877	1.266
Albany-Schenectady-Troy, NY	74.940	0.966
Albuquerque, NM	47.975	0.924
Allentown-Bethlehem-Easton, PA-NJ	67.880	1.027
Atlanta-Sandy Springs-Marietta, GA	66.290	1.049
Augusta-Richmond County, GA-SC	72.375	1.145
Austin-Round Rock, TX	65.352	1.049
Bakersfield, CA	37.086	0.350
Baltimore-Towson, MD	86.526	1.358
Baton Rouge, LA	74.780	1.139
Birmingham-Hoover, AL	75.378	1.145
Boise City-Nampa, ID	67.345	0.447
Boston-Cambridge-Quincy, MA-NH	64.322	0.996
Bridgeport-Stamford-Norwalk, CT	74.304	0.988
Buffalo-Niagara Falls, NY	78.642	1.014
Cape Coral-Fort Myers, FL	62.820	0.932
Charleston-North Charleston, SC	75.275	0.792
Charlotte-Gastonia-Concord, NC-SC	70.262	1.033
Chattanooga, TN-GA	82.436	1.252
Chicago-Naperville-Joliet, IL-IN-WI	61.026	0.833
Cincinnati-Middletown, OH-KY-IN	90.963	1.706
Cleveland-Elyria-Mentor, OH	65.568	1.163
Colorado Springs, CO	58.447	1.025
Columbia, SC	72.427	0.764
Columbus, OH	72.224	1.300
Dallas-Fort Worth-Arlington, TX	73.079	1.177
Dayton, OH	79.911	1.452
Denver-Aurora, CO	58.327	1.025
Des Moines, IA	64.671	1.237
Detroit-Warren-Livonia, MI	66.368	1.002
Durham, NC	72.568	1.067
El Paso, TX	30.684	0.483
Fresno, CA	43.063	0.390
Grand Rapids-Wyoming, MI	70.470	1.073
Greensboro-High Point, NC	71.714	1.054
Greenville, SC	66.863	0.709
Harrisburg-Carlisle, PA	75.926	1.149
Hartford-West Hartford-East Hartford, CT	82.435	1.073
Honolulu, HI	25.989	0.509
Houston-Baytown-Sugar Land, TX	61.230	0.983
Indianapolis, IN	80.378	1.632
Jackson, MS	70.854	0.990
Jacksonville, FL	67.615	1.003
Kansas City, MO-KS	69.096	1.339
Knoxville, TN	83.410	1.267
Lancaster, PA	70.088	1.061
Lansing-East Lansing, MI	72.598	1.105
Las Vegas-Paradise, NV	62.553	0.981
Lexington-Fayette, KY	80.525	1.715

Table A-12. (cont.)

Metro	MBtu/person	Carbon (metric tons/person)
Little Rock-North Little Rock, AR	72.676	1.010
Los Angeles-Long Beach-Santa Ana, CA	43.967	0.391
Louisville, KY-IN	72.028	1.532
Madison, WI	60.052	1.101
Memphis, TN-MS-AR	77.515	1.178
Miami-Fort Lauderdale-Miami Beach, FL	58.051	0.861
Milwaukee-Waukesha-West Allis, WI	60.948	1.125
Minneapolis-St. Paul-Bloomington, MN-WI	65.909	1.094
Nashville-Davidson--Murfreesboro, TN	87.735	1.336
New Haven-Milford, CT	73.865	0.994
New Orleans-Metairie-Kenner, LA	65.712	0.999
New York-Northern NJ-Long Island, NY-NJ-PA	49.201	0.670
Oklahoma City, OK	77.061	1.358
Omaha-Council Bluffs, NE-IA	68.084	1.109
Orlando, FL	58.419	0.866
Oxnard-Thousand Oaks-Ventura, CA	42.433	0.394
Palm Bay-Melbourne-Titusville, FL	57.025	0.845
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	73.676	1.114
Phoenix-Mesa-Scottsdale, AZ	51.584	0.658
Pittsburgh, PA	71.838	1.091
Portland-South Portland-Biddeford, ME	74.553	1.156
Portland-Vancouver-Beaverton, OR-WA	59.653	0.393
Poughkeepsie-Newburgh-Middletown, NY	63.771	0.824
Providence-New Bedford-Fall River, RI-MA	88.315	1.200
Raleigh-Cary, NC	70.793	1.041
Richmond, VA	85.547	1.301
Riverside-San Bernardino-Ontario, CA	40.492	0.372
Rochester, NY	74.801	0.958
Sacramento--Arden-Arcade--Roseville, CA	45.148	0.422
Salt Lake City, UT	55.056	1.046
San Antonio, TX	63.283	1.015
San Diego-Carlsbad-San Marcos, CA	37.580	0.360
San Francisco-Oakland-Fremont, CA	41.085	0.390
San Jose-Sunnyvale-Santa Clara, CA	42.152	0.389
Sarasota-Bradenton-Venice, FL	68.606	1.018
Scranton--Wilkes-Barre, PA	74.774	1.136
Seattle-Tacoma-Bellevue, WA	58.480	0.356
Springfield, MA	87.843	1.332
St. Louis, MO-IL	76.777	1.510
Stockton, CA	43.215	0.394
Syracuse, NY	75.230	0.962
Tampa-St. Petersburg-Clearwater, FL	66.570	0.988
Toledo, OH	69.282	1.235
Trenton-Ewing, NJ	65.032	0.783
Tucson, AZ	47.507	0.606
Tulsa, OK	80.591	1.424
Virginia Beach-Norfolk-Newport News, VA-NC	78.472	1.194
Washington-Arlington-Alexandria, DC-VA-MD-WV	85.783	1.958
Wichita, KS	73.030	1.319
Worcester, MA	67.124	1.038
Youngstown-Warren-Boardman, OH-PA	66.543	1.199
Average Top 100 Metros	62.491	0.925

Table A-13. Annual Energy Use and Carbon Emissions from Residential Electricity and Fuel Consumption per Million GMP (Year 2005)

Metro	MBtu/million GMP	Carbon (metric tons/million GMP)
Akron, OH	1,934	75.276
Albany-Schenectady-Troy, NY	1,843	32.779
Albuquerque, NM	1,195	22.419
Allentown-Bethlehem-Easton, PA-NJ	2,045	114.224
Atlanta-Sandy Springs-Marietta, GA	1,360	7.077
Augusta-Richmond County, GA-SC	2,312	212.489
Austin-Round Rock, TX	1,445	10.891
Bakersfield, CA	1,229	26.168
Baltimore-Towson, MD	1,943	11.371
Baton Rouge, LA	1,669	41.186
Birmingham-Hoover, AL	1,663	17.697
Boise City-Nampa, ID	1,658	53.071
Boston-Cambridge-Quincy, MA-NH	1,096	19.703
Bridgeport-Stamford-Norwalk, CT	921	19.544
Buffalo-Niagara Falls, NY	2,309	60.513
Cape Coral-Fort Myers, FL	1,676	27.455
Charleston-North Charleston, SC	1,980	25.528
Charlotte-Gastonia-Concord, NC-SC	1,005	82.179
Chattanooga, TN-GA	2,178	31.741
Chicago-Naperville-Joliet, IL-IN-WI	1,249	12.939
Cincinnati-Middletown, OH-KY-IN	2,091	23.795
Cleveland-Elyria-Mentor, OH	1,403	30.406
Colorado Springs, CO	1,606	137.151
Columbia, SC	1,901	60.861
Columbus, OH	1,490	18.603
Dallas-Fort Worth-Arlington, TX	1,349	6.380
Dayton, OH	2,072	74.257
Denver-Aurora, CO	1,047	15.344
Des Moines, IA	1,083	20.547
Detroit-Warren-Livonia, MI	1,497	16.675
Durham, NC	1,272	48.247
El Paso, TX	1,007	64.301
Fresno, CA	1,508	26.315
Grand Rapids-Wyoming, MI	1,725	159.425
Greensboro-High Point, NC	1,612	21.649
Greenville, SC	1,775	277.430
Harrisburg-Carlisle, PA	1,603	34.540
Hartford-West Hartford-East Hartford, CT	1,458	24.789
Honolulu, HI	572	8.083
Houston-Baytown-Sugar Land, TX	1,036	7.259
Indianapolis, IN	1,504	20.159
Jackson, MS	1,842	27.585
Jacksonville, FL	1,604	7.930
Kansas City, MO-KS	1,474	52.378
Knoxville, TN	2,077	18.781
Lancaster, PA	1,964	94.337
Lansing-East Lansing, MI	1,964	42.503
Las Vegas-Paradise, NV	1,329	10.176
Lexington-Fayette, KY	1,728	69.542

Table A-13. (cont.)

Metro	MBtu/million GMP	Carbon (metric tons/million GMP)
Little Rock-North Little Rock, AR	1,764	15.485
Los Angeles-Long Beach-Santa Ana, CA	899	4.612
Louisville, KY-IN	1,740	13.190
Madison, WI	1,106	25.030
Memphis, TN-MS-AR	1,718	9.965
Miami-Fort Lauderdale-Miami Beach, FL	1,359	6.832
Milwaukee-Waukesha-West Allis, WI	1,254	71.562
Minneapolis-St. Paul-Bloomington, MN-WI	1,208	14.093
Nashville-Davidson--Murfreesboro, TN	1,816	10.260
New Haven-Milford, CT	1,819	41.606
New Orleans-Metairie-Kenner, LA	1,394	38.914
New York-Northern NJ-Long Island, NY-NJ-PA	876	8.580
Oklahoma City, OK	1,907	11.879
Omaha-Council Bluffs, NE-IA	1,417	15.944
Orlando, FL	1,262	4.149
Oxnard-Thousand Oaks-Ventura, CA	1,052	45.068
Palm Bay-Melbourne-Titusville, FL	1,889	226.076
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,449	10.940
Phoenix-Mesa-Scottsdale, AZ	1,250	10.160
Pittsburgh, PA	1,677	33.129
Portland-South Portland-Biddeford, ME	1,724	32.840
Portland-Vancouver-Beaverton, OR-WA	1,309	8.208
Poughkeepsie-Newburgh-Middletown, NY	2,224	42.002
Providence-New Bedford-Fall River, RI-MA	2,407	43.496
Raleigh-Cary, NC	1,552	8.804
Richmond, VA	1,805	14.471
Riverside-San Bernardino-Ontario, CA	1,559	9.723
Rochester, NY	1,851	23.708
Sacramento--Arden-Arcade--Roseville, CA	1,087	9.215
Salt Lake City, UT	1,138	41.973
San Antonio, TX	1,783	5.801
San Diego-Carlsbad-San Marcos, CA	754	28.200
San Francisco-Oakland-Fremont, CA	637	4.247
San Jose-Sunnyvale-Santa Clara, CA	602	8.688
Sarasota-Bradenton-Venice, FL	1,994	8.497
Scranton--Wilkes-Barre, PA	2,414	125.412
Seattle-Tacoma-Bellevue, WA	1,030	5.897
Springfield, MA	3,007	27.362
St. Louis, MO-IL	1,838	8.559
Stockton, CA	1,665	30.872
Syracuse, NY	2,057	19.865
Tampa-St. Petersburg-Clearwater, FL	1,745	2.174
Toledo, OH	1,820	123.220
Trenton-Ewing, NJ	1,107	27.903
Tucson, AZ	1,623	159.763
Tulsa, OK	1,858	13.678
Virginia Beach-Norfolk-Newport News, VA-NC	1,931	7.994
Washington-Arlington-Alexandria, DC-VA-MD-WV	1,296	6.565
Wichita, KS	1,931	43.179
Worcester, MA	2,054	31.753
Youngstown-Warren-Boardman, OH-PA	2,356	44.915
Average Top 100 Metros	1,299	19.242

Table A-14. U.S. Residential Carbon Emissions from Electricity and Energy Consumption in 2000 and 2005 (in MtC)

Estimated Annual Totals:	Year 2000 [a]	Year 2005 [b]	% Change 2000-2005
Petroleum	27.5	28.6	4.0
Natural Gas	73.2	71.4	2.5
Coal	1.2	0.3	-1.2
Electricity	204.0	241.6	18.4
Total	305.9	341.9	11.8

[a] Sources: *Annual Energy Outlook 2002* (Table A19)
[b] Sources: *Annual Energy Outlook 2007* (Table A18)

Appendix B

Methodology for Estimating the Energy and Carbon Footprints from Residential Electricity Consumption in the 100 Largest U.S. Metropolitan Areas

1. Introduction

This chapter describes our methods for estimating the amount of electricity consumed by households within each of the 100 largest metropolitan areas and for estimating the amount of energy consumed and carbon emitted to create that electricity. All of this is done for the years 2000 and 2005.

Estimating the residential electricity consumption of each metro area involved six steps:

1) Estimate the average electricity consumed per residential customer of each utility serving the metropolitan area.
2) Estimate the number of households each utility serves within the metropolitan area by mapping the utilities' service districts at the zip code level.
3) Calculate the preliminary estimate of total electricity consumed in each zip code by each utility's residential customers by multiplying the average consumption per residential consumer by the number of households served.
4) Calculate preliminary estimates of the total electricity consumed by residential customers in each county.
5) Reduce the preliminary county estimates to account for landlord electricity payments, based on county-specific data on types of housing and region-specific data on how utilities are paid by housing type.
6) Sum the final estimates by county across all of the counties within each metro area to produce metro-wide estimates.

The resulting estimates of total residential electricity consumed in each metropolitan area were then compared to actual values for ten California metropolitan areas. This step allowed a reality check on our estimation methodology and led to several improvements.

The estimates of total residential electricity consumption by metro were then converted into energy consumption and carbon emissions by metro – i.e., their energy and carbon footprints. Two alternative approaches were used to convert electricity consumption into energy and carbon. The first approach uses a standard set of conversion factors for all metro areas based on the generation mix of the U.S. in 2000 and 2005. The second approach uses the fuel mix of each state's electricity generation in 2000 and 2005. Comparing these results highlights the impact of fuel mix from the impact of other determinants of footprint size, such as weather, housing stock, energy prices, and use of non-electric fuels.

2. Calculating Residential Electricity Consumption

We obtained data from Platts Analytics on the total residential MWh sold by each utility that sells electricity to any of the 100 metros, and on the total number of residential customers each utility serves.[10] Platts compiles this data from FERC Form 1 and RUS Form 12, which are filed annually by utilities with the federal government. By dividing a utility's MWh sold ($MWh_{utility}$) by the number of residential customers served (RC_{total}), we obtained an estimate of the average amount of electricity consumed per residential customer for each utility ($MWh_{utility\ average}$). Keeping the individual utility average, rather than aggregating to an overall average, is an important step because it retains sensitivity to information that causes consumption to vary (climate, rates, average housing unit size and vintage, etc.) that would otherwise be difficult to find and estimate.

$$MWh_{utility\ average} = MWh_{utility}/RC_{total}$$

See Table B-1 for an example of this calculation.

The next step is to estimate the number of households each utility serves within the metropolitan areas. Because this information is not directly available, GIS mapping is used to determine the geographic service territories of each utility. This information also came from Platts Analytics, who mapped the service territories at the zip code level to determine the proportion of each zip code served. By multiplying the service territory proportion (% Service Territory) within each zip code by the number of households in each zip code (HH_{zip}), we estimate the number of households served by that utility within the zip code (HH_{served}). We obtained the household data for 2000 from the Census Bureau, and used estimations from ESRI for 2005. Thus if there are 500 households in a zip code and a utility covers 80% of the zip code, the utility is assumed to serve 400 households.

$$HH_{served} = HH_{zip} * \%\ \text{Service Territory}$$

See Table B-2 for an example.

The third step is to calculate a preliminary estimate of the total residential electricity consumed in each zip code by the households served by each utility. This is done by first multiplying the number of households served by the utility's residential customer average (we are assuming here that a household is equivalent to a residential customer) to get the MWh consumed by that utility's customers within the zip code ($MWh_{zip\ utility}$). Next we sum the MWh for all of the utilities that serve the zip code to get the total MWh.

$$MWh_{zip\ utility} = HH_{served} * MWh_{utility\ avg}$$

See Table B-3 for an example of this calculation.

---

[10] The authors are grateful to Platts Analytics for allowing the Georgia Institute of Technology to use their national database on utility sales, and to Steve Piper and Curt Ophaug-Johansen.

The fourth step involves summing these utility-specific preliminary estimates of residential consumption by zip code (MWh_{zip}) and then summing these subtotals across all zip codes within a county (MWh_{county}).

$$MWh_{zip} = MWh_{zip\ utility\ 1} + MWh_{zip\ utility\ 2} \ldots + MWh_{zip\ utility\ k}$$

$$MWh_{county} = MWh_{zip\ 1} + MWh_{zip\ 2} \ldots + MWh_{zip\ k}$$

In summing the estimates across zip codes to obtain county totals, we took into account the tendency of zip codes to sometimes overlap county boundaries with an array of zip code allocation factors obtained from the Brookings Institution. Using the zip code allocation factors (the percentage of each zip code that falls within a county), we attributed to each county an estimate of only the zip code MWh consumed within that particular county. For example, if only 50% of a zip code fell within a county's boundaries only 50% of its MWh would be included in the county preliminary MWh total.

In the fifth step we reduce the preliminary county estimates to account for landlord electricity payments, based on county-specific data on types of housing and region-specific data on how utilities are paid by housing type. Information on how utilities are paid was provided by the Energy Information Administration based on microdata from the 2001 Residential Energy Consumption Survey.[11] Specifically:

# of Residential Customers = (#Mobile Homes * % Paid by HH) + (#Single Family Detached * % Paid by HH) + (#Single Family Attached * % Paid by HH) + (#2-4 Unit Apts * %Paid by HH) + (#5+ Unit Apts * % Paid by HH)

In the sixth and final step, we sum the county MWh for each county within the metro area to determine the metropolitan area's MWh total.

$$MWh_{metro} = MWh_{county\ 1} + MWh_{county\ 2} \ldots + MWh_{county\ k}$$

See Table B-5 for an example.

3. Comparing our Estimates with County and Metro-Level Data for Ten California Metros

Data on residential electricity consumption in the years 2000 and 2005 is publicly available for all of the counties of California (www.energy.ca.gov/electricity/index.html). To our knowledge, residential electricity consumption data is not available at the county or metro level for any other states. We arrived at this conclusion after requesting county- and metro-level electricity consumption data for the 100 metro areas from their respective State Energy Offices as well as Public Utility Commissions, the U.S. Department of

[11] Stephanie Battles (Energy Information Administration) provided the microdata summarized in Table 4.

Energy's Energy Information Administration, and trade organizations such as the Electric Power Research Institute and the Edison Electric Institute.

As a result, the assessment of our estimates with data reported by utilities to the State of California is limited to the ten California metropolitan areas. Since California reports data at the county level, we used both county and metro totals to evaluate how closely our estimates of residential electricity consumption brought us to the utility-reported numbers as summarized by the California Energy Commission.

After refining our methodology several times (e.g., moving from county-level analysis to zip code level and adding the "who pays" correction for utility payments), on average our calculations bring us within 20% of the actual data (Table B-7). The largest over-estimates are for San Francisco and San Jose in 2000 and for Los Angeles in 2005. Since these same three metros were quite accurately estimated in the other years, the two years of data are being compared to identify any possible data errors. The same is being done for the metros that are under-estimated.

4. Estimating Energy Consumption and Carbon Emissions from Electricity

Now that we have estimated the amount of residential electricity consumed by the metropolitan areas, our next step is to determine the amount of energy consumed and carbon emitted to produce the electricity, by metro – i.e., their energy and carbon footprints. The amount of energy consumed and carbon emitted per MWh of electricity produced varies according to the type of fuel used. Two alternative approaches were used to convert electricity consumption into energy and carbon. Comparing these results highlights the impact of fuel mix from the impact of other determinants of footprint size, such as weather, housing stock, energy prices, and use of non-electric fuels.

The first approach uses a standard set of conversion factors for all metro areas based on the generation mix of the U.S. in 2000 and 2005. Table B-8 shows the derivation of these conversion factors based on data from the Energy Information Administration's *Annual Energy Outlook*.

The second approach uses EIA's estimation of each state's annual carbon dioxide emissions produced by that state's electricity generation in 2000 and 2005. Data on the amount of electricity produced in each state and the amount of carbon dioxide emitted from the generation of electricity is published annually by EIA in its *State Electricity Profiles.* For the year 2000, we divide the amount of carbon dioxide emitted by the amount of electricity generated to obtain the average tons of CO2 emitted per MWh. We then convert the CO2 into an estimate of the average metric tons of carbon emitted per MWh generated within the state. For 2005, the EIA published its own estimate of the lbs of CO2 emitted per MWh generated in each state. We simply convert this figure into metric tons of carbon per MWh. Comparisons between 2000 and 2005 show that our estimates are very consistent. Tables B-9 and B-10 show all of the state-level estimates.

We assume that the state average is the same as the average for a metropolitan area within it. We multiply the average amount of carbon emitted per MWh by the number of MWh consumed by the metropolitan area.

$$\text{Carbon}_{\text{metro}} = \text{MWh}_{\text{metro}} + \text{Carbon}_{\text{state avg}}$$

See Table B-6 for an example.

Thus, we reach our final estimation – the amount of carbon emitted from residential electricity consumption within a metropolitan area. We run this calculation with data from 2000 and 2005 for each of our 100 metropolitan areas.

Table B-1 Example of MWh Utility Average Calculation

Riverside County (Riverside, CA)				
ZIP	**Company Name**	**Residential MWh**	**Residential Consumers**	**MWh Utility Avg**
92210	Southern California Edison Co.	514641	58541	8.791121
92210	Imperial Irrigation District	1167301	84289	13.84879
92211	Southern California Edison Co.	514641	58541	8.791121
92211	Imperial Irrigation District	1167301	84289	13.84879
92220	Banning Electric Dept.	52034	8817	5.901554
92220	Southern California Edison Co.	514641	58541	8.791121
92223	Southern California Edison Co.	514641	58541	8.791121

Table B-2. Example of Households Served Calculation

Riverside County (Riverside, CA)				
ZIP	**Company Name**	**Service Territory**	**HH Zip***	**HH Served**
92210	Southern California Edison Co.	0.353013	2031	716.9694
92210	Imperial Irrigation District	0.646995	2031	1314.047
92211	Southern California Edison Co.	0.711716	9456	6729.986
92211	Imperial Irrigation District	0.288279	9456	2725.966
92220	Banning Electric Dept.	0.131649	9529	1254.483
92220	Southern California Edison Co.	0.868361	9529	8274.612
92223	Southern California Edison Co.	1	6452	6452

* Number of households within zip code after allocation factor

Table B-3. Example of MWh Zip Utility Calculation

Riverside County (Riverside, CA)				
ZIP	**Company Name**	**MWh Utility Avg**	**HH Served**	**MWh Zip Utility**
92210	Southern California Edison Co.	8.791121	716.9694	6302.965
92210	Imperial Irrigation District	13.84879	1314.047	18197.96
92211	Southern California Edison Co.	8.791121	6729.986	59164.12
92211	Imperial Irrigation District	13.84879	2725.966	37751.34
92220	Banning Electric Dept.	5.901554	1254.483	7403.401
92220	Southern California Edison Co.	8.791121	8274.612	72743.11
92223	Southern California Edison Co.	8.791121	6452	56720.31

Table B-4. Percentage of Households Who Pay Directly for All Utilities (Source: Microdata from 2001 Residential Energy Consumption Survey)

Census Region:	Mobile Homes	Single-Family Detached	Single-Family Attached	Apartment in 2-4 Unit Building	Apartment in 5 or More Unit Building
Northeast	91.07	98.57	93.64	68.74	30.30
Midwest	97.95	99.22	95.09	74.18	41.71
South	98.86	98.81	93.16	81.36	63.48
West	88.77	98.56	96.10	72.56	63.49

Figure B-1. U.S. Census Regions

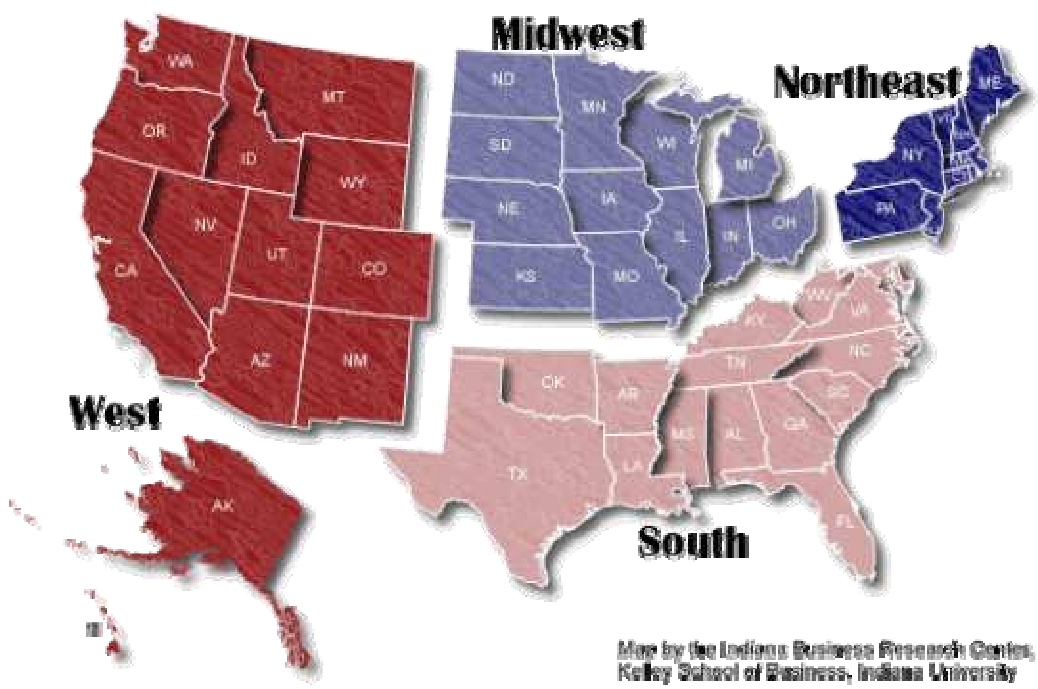


Table B-5. Example of MWh per County Adjusted for Landlord Utility Payments

Sacramento	**MWh per County**
El Dorado	921,166
Placer	850,087
Sacramento	3,031,398
Yolo	424,003
MWh Metro	5,226,654

Table B-6. Example of calculation of Carbon emissions from California Metros in 2005

Metro	**Residential MWh**	**State Avg Emissions (metric tons/MWh)**	**Carbon (tons)**
Bakersfield	1,619,925	0.0745	120684
Fresno	2,383,687	0.0745	177585
Los Angeles	37,054,238	0.0745	2760541
Oxnard	2,020,958	0.0745	150561
Riverside	9,670,391	0.0745	720444
Sacramento	5,424,169	0.0745	404101
San Diego	6,201,913	0.0745	462043
San Francisco	9,797,494	0.0745	729913
San Jose	4,495,721	0.0745	334931
Stockton	1,785,648	0.0745	133031

Table B-7. Comparison of State of California and Georgia Tech/Platts Estimates of Residential Energy Consumption in 10 California Metros

	CA Estimates (in MWh)	Estimates (in MWh)	% Difference
For Year 2000:			
Bakersfield	1,725,615	1,684,780	98%
Fresno	1,725,615	2,192,644	127%
Los Angeles	25,251,253	26,293,876	104%
Oxnard	1,652,837	1,782,046	108%
Riverside	8,922,192	7,772,805	87%
Sacramento	6,232,666	4,841,946	78%
San Diego	5,890,053	6,083,535	103%
San Francisco	9,344,966	13,396,689	143%
San Jose	3,959,242	5,493,963	139%
Stockton	1,515,170	1,944,216	128%
	CA Estimates (in MWh)	**Estimates (in MWh)**	**% Difference**
For Year 2005:			
Bakersfield	1,959,712	1,619,925	83%
Fresno	2,363,155	2,383,687	101%
Los Angeles	26,267,630	37,054,238	141%
Oxnard	1,764,324	2,020,958	115%
Riverside	10,551,914	9,670,391	92%
Sacramento	7,044,590	5,424,169	77%
San Diego	6,330,072	6,201,913	98%
San Francisco	9,331,939	9,797,494	105%
San Jose	3,978,140	4,495,721	113%
Stockton	1,631,146	1,785,648	109%

Table B-8. Energy and Carbon Conversion Factors based on National Statistics for Electric Power in 2000 and 2005

	2000[a]	2005[b]
Total electricity sales (Million MWh)	3,426	3,660
Total quads of energy consumed by electric power generation (quads)	36.92	39.71
Total carbon dioxide emissions from electric power (in million metric tons)	2,147	2,375
Total carbon emissions from electric power (in million metric tons)	585.5	647.7
Conversion factors:		
Primary Energy Conversion Factors for Site Electricity (Btu per kWh)	10,776	10,850
Carbon Conversion Factors for Site Electricity (metric tons of CO2 per MWh)	0.6267	0.6489
Carbon Conversion Factors for Site Electricity (metric tons of C per MWh)	0.1709	0.1770

[a] Sources: *Annual Energy Outlook 2002* (Tables A2, A8 and A19)
[b] Sources: *Annual Energy Outlook 2007* (Tables A2, A8 and A18)

Table B-9. Carbon Conversion Factors Based on State-level Electricity Generation and Emissions for 2000

State	CO2 (thousand metric tons)	Total MWH	Metric tons CO2/MWh	Metric tons Carbon/MWh
Alabama	80512	124,405,340	0.6472	0.1765
Arizona	45,250	88,946,577	0.5087	0.1387
Arkansas	28,615	43,875,766	0.6522	0.1779
California	67,411	208,082,483	0.3240	0.0884
Colorado	39,535	44,165,546	0.8952	0.2441
Connecticut	12,532	32,967,570	0.3801	0.1037
District of Columbia	169	144,374	1.1706	0.3192
Florida	123,727	191,815,840	0.6450	0.1759
Georgia	81,603	123,877,413	0.6587	0.1797
Hawaii	8,582	10,593,403	0.8101	0.2209
Idaho	821	11,910,442	0.0689	0.0188
Illinois	93,345	178,496,081	0.5230	0.1426
Indiana	122,503	127,819,516	0.9584	0.2614
Iowa	41,244	41,542,010	0.9928	0.2708
Kansas	36,553	44,815,905	0.8156	0.2224
Kentucky	86,590	93,006,083	0.9310	0.2539
Louisiana	57,537	92,865,635	0.6196	0.1690
Maine	6,544	14,047,947	0.4658	0.1270
Maryland	32,117	51,145,380	0.6280	0.1713
Massachusetts	24,582	38,697,881	0.6352	0.1732
Michigan	77,804	104,209,594	0.7466	0.2036
Minnesota	37,249	51,423,339	0.7244	0.1976
Mississippi	22,316	37,614,563	0.5933	0.1618
Missouri	65,981	76,593,939	0.8614	0.2349
Nebraska	19,478	29,109,863	0.6691	0.1825
Nevada	24,521	35,484,915	0.6910	0.1885
New Jersey	21,808	58,085,215	0.3754	0.1024
New Mexico	31,996	33,611,643	0.9519	0.2596
New York	61,358	138,079,075	0.4444	0.1212
North Carolina	73,334	122,274,356	0.5997	0.1636
Ohio	124,647	149,060,280	0.8362	0.2281
Oklahoma	46,245	55,571,957	0.8322	0.2270
Oregon	8,174	51,789,975	0.1578	0.0430
Pennsylvania	122,865	201,687,980	0.6092	0.1661
Rhode Island	2,864	5,971,545	0.4796	0.1308
South Carolina	38,117	93,346,240	0.4083	0.1114
Tennessee	64,286	95,838,584	0.6708	0.1829
Texas	262,280	377,742,365	0.6943	0.1894
Utah	32,882	36,609,074	0.8982	0.2450
Virginia	48,031	77,189,370	0.6222	0.1697
Washington	15,523	108,236,880	0.1434	0.0391
Wisconsin	50,881	59,644,417	0.8531	0.2327

Source: *State Electricity Profiles 2005* (Tables 5 and 7 from each state)

Table B-10 Carbon Conversion Factors Based on State-level Electricity Generation and Emissions for 2005

State	CO2 (lbs/MWh)	CO2 (metric tons/MWh)	Metric tons Carbon/MWh
Alabama	1340	0.6078	0.1658
Arizona	1116	0.5062	0.1381
Arkansas	1216	0.5516	0.1504
California	602	0.2731	0.0745
Colorado	1815	0.8233	0.2245
Connecticut	758	0.3438	0.0938
District of Columbia	2278	1.0333	0.2818
Florida	1304	0.5915	0.1613
Georgia	1440	0.6532	0.1781
Hawaii	1728	0.7838	0.2138
Idaho	272	0.1234	0.0336
Illinois	1145	0.5194	0.1416
Indiana	2065	0.9367	0.2555
Iowa	2007	0.9104	0.2483
Kansas	1809	0.8205	0.2238
Kentucky	2036	0.9235	0.2519
Louisiana	1359	0.6164	0.1681
Maine	826	0.3747	0.1022
Maryland	1395	0.6328	0.1726
Massachusetts	1244	0.5643	0.1539
Michigan	1427	0.6473	0.1765
Minnesota	1617	0.7335	0.2000
Mississippi	1230	0.5579	0.1522
Missouri	1938	0.8791	0.2397
Nebraska	1547	0.7017	0.1914
Nevada	1423	0.6455	0.1760
New Jersey	768	0.3484	0.0950
New Mexico	2054	0.9317	0.2541
New York	907	0.4114	0.1122
North Carolina	1289	0.5847	0.1595
Ohio	1851	0.8396	0.2290
Oklahoma	1653	0.7498	0.2045
Oregon	401	0.1819	0.0496
Pennsylvania	1281	0.5811	0.1585
Rhode Island	948	0.4300	0.1173
South Carolina	879	0.3987	0.1087
Tennessee	1359	0.6164	0.1681
Texas	1438	0.6523	0.1779
Utah	2074	0.9408	0.2566
Virginia	1332	0.6042	0.1648
Washington	322	0.1461	0.0398

Wisconsin	1925	0.8732	0.2381

Source: *State Electricity Profiles 2005* (Table 1 from each state

Appendix C

Methodology for Estimating the Energy and Carbon Footprints from Residential Fuel Consumption in the 100 Largest U.S. Metropolitan Areas

1. Introduction

This chapter describes our methods for estimating the amount of fuel (natural gas, heating fuel, etc) consumed by households within each of the 100 largest metropolitan areas and for estimating the amount of energy consumed and carbon emitted in combusting all of that fuel. All of this is done for the years 2000 and 2005.

Estimating the residential fuel consumption of each metro area involves the following steps:

1) Estimate the average amount of each fuel consumed by the households in each state.
2) Determine the percentage of each fuel consumed by housing unit type (single family, apartment, etc) in comparison with the national average.
3) Determine the number of households in each metropolitan area by housing unit type.
4) Calculate the average amount of fuel used by each housing unit type with the state average consumption and the estimated percentage for that housing unit type.
5) Calculate the total amount of fuel consumption by multiplying the average fuel use of each housing unit type by the number of those households within the metro area.
6) Sum the fuel consumption of all the housing unit types for the total amount of each fuel consumed within the metro area.

The estimates of residential fuel consumption by metro were then converted into energy consumption and carbon emissions by metro – i.e., their energy and carbon footprints. Each fuel type was converted using a separate fuel conversion factor.

2. Calculating Residential Fuel Consumption

EIA publishes information on the amount of energy consumed by states annually. The information is broken down by fuel source and end use. We used the data on amount of fuels consumed by the residential sector of each state in which our metropolitan areas are located. We estimated the average amount of fuel (in MBtu) consumed by household within the state by dividing the total amount consumed by the number of households in the state. We did this for each type of fuel – natural gas, fuel oil, kerosene, LPG, and wood. (See Table C-1)

$\text{Mbtu}_{\text{state HH average}} = \text{Fuel}_{\text{state total}} / \text{\# HH}$

The next step is to use data from RECS[12] on the national average fuel consumption by housing type. This information tells us what percent of the national average each housing type consumes. It is important to have some way of accounting for housing unit type because fuel consumption can vary greatly by type and metropolitan areas tend to be denser and have more apartments and fewer single family residences than the state average. Accounting for these variations provides us with more accurate estimates. The housing type categories used are single family, 2-4 unit, 5+ unit, and mobile home. So, if the national average consumption of natural gas is 72 MBtus, and the average for a single family home is 82 MBtus, then the average single family home consumes 114% of the average. We used these percentages to develop factors for estimating metro area consumption from the state average developed above. (See Table C-2)

We then used Census data to find the number of households in each housing unit type for each county within the metro area. The counties were summed to find the total households by type for the metro.

We multiplied the state average consumption (for each fuel) by the housing unit factor to get the average fuel consumed by that housing unit type. This average was multiplied by the number of households of that housing unit type within the metro. We did this for each housing unit type and then summed all the types to get the total metro area consumption for that fuel. This was done for each fuel. (See Table C-3)

$\text{MBtu}_{\text{state HH average}} * \text{HU\%} = \text{MBtu}_{\text{state HU average}}$

$\text{MBtu}_{\text{state HU average}} * \text{\#HH}_{\text{Single Family}} = \text{MBtu}_{\text{metro Single Family}}$

$\text{MBtu}_{\text{metro Single Family}} + \text{MBtu}_{\text{metro 2-4 unit}} + \text{MBtu}_{\text{metro 5+ unit}} + \text{MBtu}_{\text{metro mobile home}} = \text{MBtu}_{\text{metro}}$

3. Estimating Carbon Emissions from Fuel Consumption

Once we had estimates for the total energy consumption of all metro areas for each fuel type, we could determine the amount of carbon emissions from this consumption. This was simply a matter of multiplying the amount of energy consumed by a factor of carbon emitted per unit consumed. The EPA has published carbon content coefficients for natural gas, kerosene, fuel oil, and LPG.[13] We used these coefficients in our estimates of

[12] Residential Energy Consumption Survey, published by the EIA. We used data from 2001.

[13] U.S. Environmental Protection Agency (EPA). 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2001. Annex B. Washington, DC: U.S. EPA.

the amount of carbon emitted for each fuel. We assumed that wood, as a renewable fuel, had no emissions.

Table C-1. State Household Average

Akron Residential Fuels 2000			
	MBtus	HH Ohio	Avg Consumption
Nat Gas	358500000	4,445,773	80.63839517
Fuel Oil	17500000	4,445,773	3.936323335
Kerosene	2400000	4,445,773	0.539838629
LPG	23300000	4,445,773	5.240933354
Wood	11400000	4,445,773	2.564233487

Table C-2. Housing Unit Type Fuel Factors

	Single	2-4 Unit	5+ Unit	Mobile
Natural Gas	1.138122	0.990331	0.392265	0.83011
Fuel Oil	1.115055	1.155447	0.483476	0.489596
Kerosene	0.73913	0	0	2.037267
LPG	1.032338	0	0	0.90796
Wood	1.03861	0	0.084942	0.760618

Table C-3. Consumption of Natural Gas

# of Single Family HH	Avg State Consumption	Avg Single Family Consumption	Single Family Consumption
202669.4	80.6384	91.7763	18600244
# of 2-4 Unit HH	Avg State Consumption	Avg 2-4 Unit Consumption	2-4 Unit Consumption
24918.98	80.6384	79.85874	1989998.7
# of 5+ Unit HH	Avg State Consumption	Avg 5+ Unit Consumption	5+ Unit Consumption
39018.38	80.6384	31.63164	1234215.1
# of Mobile Home HH	Avg State Consumption	Avg Mobile Home Consumption	Mobile Home Consumption
7576.54	80.6384	66.93878	507164.32
Total Akron Consumption of natural gas			22,331,623