Missing the Forest through the Trees? Comment on Reid Ewing and Fang Rong's "The Impact of Urban Form on U.S. Residential Energy Use"

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Abstract

This article critically evaluates Ewing and Rong's analysis, which suggests that low-density, single-family housing is more energy intensive than higher-density development and thus justifies more stringent antisprawl growth controls. While the empirical analysis is fundamentally sound, the data and methods that were used do not justify the conclusions.

Four primary weaknesses in the analysis are the focus of this article: the unfortunate tendency to nest the work in environmental alarmism; the failure to recognize the importance of choice and the trade-offs implicit in policy recommendations; the failure to consider the ways innovation and technological change influence energy consumption and the choice of policy tools; and the failure to recognize market-based alternatives, particularly energy pricing reforms, that might more directly influence energy conservation. Low-density, single-family housing may in fact be consistent with policies that promote energy conservation and may spur innovations that improve energy efficiency and alternatives.

Keywords: Energy; Land use; Smart growth

Introduction

The planning profession's relentless attack on detached single-family dwellings continues with the largely empirical analysis by Ewing and Rong, who find that single-family low-density housing is more energy intensive than higher-density housing. As a consequence, urban regions that "sprawl" more use more energy than those that do not. Public policy, they conclude, should actively discourage sprawl—single-family detached housing segregated from commercial and other residential uses—in favor of higher-density dwellings in order to reduce residential energy use and save the earth by mitigating climate change.

The authors use multiple regression analysis to test for the effects of house and household size, income, the age of the housing, general development patterns, and other demographic factors on residential energy use. Of particular importance to their thesis is the degree to which urban sprawl encourages energy consumption. Not surprisingly, their empirical results find that sprawling counties use more energy than compact ones. They use these results as the basis for their conclusion that planners and policy makers should adopt administrative regulations that limit sprawl and promote density, such as removing density caps, adopting minimum densities, imposing urban growth boundaries, creating geographic limits on expanding core infrastructure, and so on.

Unfortunately, while Ewing and Rong base their analysis on a fundamentally sound empirical methodology, their policy recommendations are problematic at best and do not follow directly from their methodology. Moreover, their recommendations ignore important public policy questions about quality of life, lifestyle and standard of living trade-offs, and alternative choices that should be central to policy discussions. Their analysis may also have led them to inadvertently ignore or significantly discount alternative policy proposals that would have a more direct impact on the outcomes they want to influence. Thus, I believe that their article provides little practical insight for policy makers, although it does represent a marginally valuable addition to the empirical literature on the relationship between urban form and various energy-related factors.

The following sections focus on the problematic aspects of Ewing and Rong's policy discussion and recommendations, emphasizing important shortcomings in four primary areas:

1. The unfortunate tendency to nest the work in environmental alarmism
2. The failure to recognize the importance of choice and the trade-offs implicit in policy recommendations
3. The failure to integrate the ways innovation and technological change influence current and future energy consumption and the choice of policy tools
4. The failure to recognize the value of market-based policy alternatives that might influence energy conservation, particularly energy pricing reform, in more direct and effective ways to promote energy conservation

Indeed, low-density, single-family housing can be consistent with policies promoting energy conservation and spurring innovations that improve energy efficiency and alternatives.

Environmental alarmism

The thesis Ewing and Rong propose is direct, although the introduction to their article is disappointingly partisan in that it relies on environmental alarmism to frame their research and policy recommendations. Energy use has become a more important issue in recent years as research has highlighted the potential consequences of global warming on the earth's ecology. Research in the natural sciences has identified anthropogenic greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, etc.) generated from fossil fuels such as coal and oil as significant contributors to global warming (Intergovernmental Panel on Climate Change [IPCC] 2007), implying that increased energy conservation could reduce absolute levels of these emissions and slow (if not reverse) global warming.

Ewing and Rong offer the plausible conjecture that human settlement patterns may influence the type and quantity of energy used and thus greenhouse gas emissions. More specifically, low-density residential living patterns that accommodate larger homes and more extensive travel may increase energy consumption, contributing to the production of greenhouse gases. If low-density, spatially segregated land uses increase the consumption of energy produced from fossil fuels, then altering settlement patterns and funneling people and employment into higher-density, mixed-use settings could help meet targets for greenhouse gas emissions, either as part of a unilateral policy or a multinational treaty such as the Kyoto Protocol. More controversially, Ewing and Rong also cite an impending shortage of fossil fuels, most notably oil, as another reason to encourage less energy use and a move toward more compact, presumably less energy-intensive, land uses.

Unfortunately, Ewing and Rong have unnecessarily rooted their case for policy reform in a sensationalist interpretation of the climate change literature, creating the illusion that immediate and drastic intervention in housing and land use by local and state governments and possibly the federal government is needed to address what is, by all accounts, a long-term problem. They favorably cite "Oregon-style growth management" (23), which relies heavily on urban growth boundaries and policies that encourage significantly higher-density development, but fail to point out that this regional planning approach is a radical step in the context of American land use planning that has significantly constrained the range of affordable and market-based housing choices in the Portland area (Mildner 2001; Staley, Edgens, and Mildner 1999). More important, alternative public policies such as marginal-cost pricing for electricity and water may achieve the same goals while preserving a wider range of choices and providing stronger incentives for innovation. I will return to this point later.

Moreover, while the scientific community appears to have reached a consensus that the temperature of the earth is rising, that the ecological consequences of this warming could be significant, and that anthropogenic impacts are likely a significant contributor (IPCC 2007), there is no similar consensus on what the appropriate policy responses should be. Indeed, an important debate on the policy response to global climate change is only now beginning, with significant discussion about whether the principal approaches should focus on mitigation or adaptation (see, for example, Avery and Singer 2007 and Lomberg 2007). Even if a radical change in emissions patterns (e.g., stabilizing carbon dioxide at 2000 levels) could be achieved immediately, significant warming would still occur throughout most of this century (IPCC 2007). Achieving absolute levels of reduction that would bring the atmosphere back into the "natural" range would require lowering carbon dioxide levels below 300 parts per million (ppm) (IPCC 2007). (Carbon dioxide has been increasing at about 2 ppm every year, and the global concentration of carbon dioxide in 2005 was 379 ppm.) Further, even if the United States could reduce current emissions, the buildup of carbon dioxide (and other greenhouse gases) ensures a warming climate for decades. Thus, even under the best scenario, improvements are unlikely to be felt until well into the 22nd century.

The problem with succumbing to sensationalist rhetoric urging radical action now is that it makes weighing alternative policy recommendations difficult and oversells the prescriptions for advocates of specific policy proposals, a point I will discuss in more detail later. There is significant uncertainty over which proposals are most cost-effective, practical, and useful, and none comes without important trade-offs for human welfare and freedom.

That the relationship between the changes Ewing and Rong recommend and climate change is problematic is demonstrated by a recent report from the Australian Conservation Fund (ACF), the University of Sydney, and the New Environment Trust (ACF 2007). This research focused on the impact of urban settlement in Sydney, Australia, and found that direct household and personal energy use accounted for just 30 percent of greenhouse gas emissions, 23 percent of total water use, and 10 percent of Sydney's total eco-footprint (ACF 2007). "If every Australian household switched to renewable energy and stopped driving their cars tomorrow," the report observed, "total household emissions would decline by only about 18 percent" (ACF 2007, 5). Thus, the impact of changing land use patterns to reduce energy consumption and thus greenhouse gas emissions would likely be much smaller. Even taking Ewing and Rong's results at face value, the average family would consume 20 percent less energy if it moved from a sprawling county (one standard deviation below the mean) to a compact county (one standard deviation above the mean).

Choice, living standards, and energy use

Another concern is the failure by these authors to consider the impact of their policy recommendations on consumer choice or the consumer welfare and policy trade-offs adopting them implies. The article presumes that public policy should focus on reducing energy use even though this prescription involves substantial negative implications for an economic and political system that values choice, diversity, and innovation. Ewing and Rong write, "The geopolitics of oil make headlines, but energy use by the U.S. residential sector is also a significant long-term threat to the planet" (5). In other words, rising absolute levels of energy use per se are the threat to the planet, implying that consumer preferences and rising standards of living undermine planetary survival and that reducing consumption inevitably involves limiting consumer choice. Presumably, the threat manifests itself in burning more fossil fuel to generate energy and upsetting the fragile balance between energy supply and demand, where the "imbalance is projected to have dire economic consequences when conventional oil production eventually peaks, as it must for this nonrenewable resource" (1).

This is an exceedingly narrow understanding of energy use and energy markets, since Ewing and Rong's argument for reducing energy use (and ultimately limiting the availability of single-family detached housing) depends almost exclusively on the urgent need to reduce the use of oil. But coal supplies stretch easily into thousands of years (Bradley and Fulmer 2004). It is more instructive, perhaps, to note that wood, once the dominant source of energy, has not been a significant source of production in industrialized nations for more than a century. Energy sources shift, depending on resource availability and technological change. A shift to nuclear power would dramatically extend the time horizon of energy sources, making current predictions of future energy use in the residential sector pointless. Nuclear power, while still relying on uranium, burns it cleanly (with no greenhouse gas emissions) and produces far more energy. (The primary concerns with nuclear energy revolve around storing nuclear waste and overcoming political barriers, not the ability to generate electricity efficiently as a substitute for conventional fossil fuels such as coal, oil, or natural gas.) Moreover, technology and rising industry (and regulatory) standards have minimized substantive concerns over reactor safety in high-income nations (see Spencer and Loris 2007, for a brief, albeit nonacademic, review of the current state of the industry).

Technology, consumption trends, and policy choice

A more troubling characteristic of the policy framework Ewing and Rong espouse, however, is the failure to place current energy use and innovation in a historical context and discuss the implications for their policy prescriptions. This is important because they are advocating specific types of land use policy interventions, including stringent controls on development, based on both identified impacts on energy use by the residential sector and a sense of urgency derived from the belief that action is needed now. To the extent that the conclusions from this empirical analysis are weakened, policy makers should consider options and recommendations that are relatively less intrusive and more accommodating to human preferences and quality of life considerations.

Ewing and Rong's empirical analysis is cross-sectional, representing a snapshot of energy use and consumption in the late 1990s. Yet, particularly since the Middle Ages, modern (market-based) societies have successfully shifted their primary source of energy based on the relative availability of natural resources at given points in history. At one time, England depended on wood as a primary source of energy. As timber became scarcer, innovation led to more efficient uses of steam power, and coal became more widespread as a primary source for generating energy. When oil was discovered and refining processes and engine technologies improved, economies shifted to oil-based energy production because it was more efficient and effective. Fossil fuels account for about 85 percent, and oil about 40 percent, of current U.S. energy consumption (Energy Information Administration 2007). There is little in human history, particularly the history of industrialized nations, to suggest that similar shifts will not occur as existing resources (oil) become scarcer or that technology will not extend the economic viability of these resources as a primary source of energy that can be burned cleanly. Thus, a weakness in Ewing and Rong's policy framework and empirical methodology is the general failure to incorporate how market prices influence historical consumption trends and have influenced energy use, incentives to conserve, and propensities to identify, cultivate, and implement alternatives (see also the discussion in Staley 2006).

The economic viability of extracting, processing, and generating power from natural resources is, of course, of paramount concern, but Ewing and Rong do not address whether the speed at which markets can adjust to energy sources might influence their policy recommendations on what kinds of land use regulations and growth management strategies might make sense under different scenarios and how they might be used. Clearly, an innovation time horizon of 100 years requires a different policy response than one spanning a decade. This is particularly relevant to discussions about fossil fuel–based technologies and transportation. Sprawl, it is claimed, is made possible by the widespread use of the automobile, which currently depends on fossil fuels for energy. What are the policy implications for antisprawl growth controls if (or when) automobiles no longer depend on oil for fuel?

Indeed, the first automobiles were steam powered. Solar energy was used to power water heaters in the 1890s and remained economically viable through the 1930s and 1940s before fossil fuel–generated electricity (from coal, natural gas, or oil) provided cheaper alternatives that were also more energy efficient. The industrial revolution experienced a series of innovations in steam power that increased its efficiency, sometimes by changing the source of fuel, but more often by improving the technology used to convert fuel into power. As a current example, J. D. Power and Associates (2007) forecasts that as many as 65 models of hybrid gasoline-electric vehicles will be on the market by 2010.

Technological shifts were not random; they were the result of economic forces spurring innovation and adaptation to new, more efficient ways of producing energy. Sometimes these shifts were made out of necessity (excessive hunting of whales for oil), because of political exigency (the need for wood to build warships), or because of economic efficiency (gasoline and the internal combustion engine). The implications for land use policy and Ewing and Rong's recommendations are significant. Technology that allows homes and automobiles to be powered economically through solar power or some other clean, renewable source would effectively eliminate the need to reduce energy use as a primary policy goal.

While a universal application of clean technology cannot be implemented efficiently now, policy recommendations should at least acknowledge the plausibility that such technology will become more viable and note the trends toward increasing viability. Moreover, as natural resources become scarcer and market prices increase, the incentives to find cost-effective alternatives increase dramatically.

Ewing and Rong's dismissal of this potential is somewhat odd, given the evidence to the contrary in their data analysis. Suburbs today are much more energy efficient than cities were 50 or 100 years ago: Older homes are less efficient, requiring more energy per square foot to heat. Older homes in older neighborhoods could exacerbate transportation problems as jobs move to the suburbs and so-called reverse-commuting becomes more common (see Pisarski 2007). Suburban homes, by contrast, are more energy efficient per square foot, although these savings are offset by an "income effect"—the desire to live in larger homes with more amenities (e.g., dishwashers, clothes dryers) and use transportation modes that allow for more flexibility, mobility, and choice (automobiles). Higher incomes also allow families to adopt energy-saving technologies, such as replacing windows with better-insulated ones or designing homes to take advantage of passive solar heating, or to choose environmentally friendly alternatives such as solar panels despite their lower overall efficiency. In the end, the culprit in higher energy use is more likely higher incomes with expectations about quality of life and standard of living rather than urban form per se.

While this conclusion may seem stark, it flows as a direct consequence from the conclusions Ewing and Rong draw from their research. Their article is focused on levels of energy use, presuming (1) that higher energy use has net negative impacts on the environment and (2) that these rates of use will continue as part of a straight-line increase into the future. Any offsetting benefits that might come from higher standards of living and lifestyles, such as improved energy efficiency or shifts from current constrained energy sources like oil, are not part of their analytical framework.

Even if households' values and preferences were considered, the methodological framework Ewing and Rong use does not allow for clear or direct policy recommendations, particularly if they advocate specific land use outcomes. Their empirical framework relies on county-level data, and the choice of this unit of analysis may obscure more than it reveals: County-level analysis runs the risk of excessive aggregation—identifying empirical trends on an aggregate level that may not be accurate or reflective of meaningful trends.

For example, New York County is composed entirely of Manhattan, a relatively small geographic area with the nation's highest average population density: 66,940 people per square mile (U.S. Bureau of the Census 2000). Bronx County and Kings County (Brooklyn) have the nation's second- and third-highest population density (about 30,000 people per square mile), followed by Queens County (about 20,409 people per square mile), San Francisco County (16,634 people per square mile), and Philadelphia (11,000 people per square mile). Yet housing and transportation patterns vary dramatically between counties at the higher end of the density spectrum, with potentially significant implications for energy use in transportation. For example, Manhattan residents rely on walking or transit to commute to work. Less than 5 percent use a car (Office of the Mayor n.d.). In Brooklyn and the Bronx, the automobile accounts for almost half of the commuting trips, and walking accounts for a larger share than transit (Office of the Mayor n.d.). In Queens, the city with the nation's fourth-highest density, 60 percent of commuting trips are by automobile (Office of the Mayor n.d.). Thus, substantial changes in energy use can occur within relatively narrow ranges of density, suggesting important nonlinear relationships. Ewing and Rong's methodology does not permit this kind of more finely grained analysis or control for the effects of outliers.

In an attempt to remedy the problem of excessive aggregation, Ewing and Rong disaggregate their housing component into three classes—detached single-family housing, attached single-family housing (town houses/duplexes), and multifamily housing. They assume that these categories capture the relevant factors driving energy use. But using county data still hides more than it reveals. Energy use varies by lifestyle choices (doing laundry in the home rather than at a Laundromat), the state of current technology (double-pane versus single-pane windows), and work arrangements (telecommuting), not just architecture. An analysis of carbon dioxide emissions based on housing structures in Australia casts doubt on the assumptions underlying geographically aggregated data (Myors, O'Leary, and Helstroom 2005).

The government of New South Wales, Australia, commissioned a study to determine how much greenhouse gas was produced by multifamily housing units in Sydney (Myors, O'Leary, and Helstroom 2005). A total of 4,043 apartments in 100 buildings at 52 sites, ranging from high rises (nine stories or more) to town houses and villas (two or more detached dwellings with common areas), were examined. Only town houses and villas emitted less carbon dioxide per person than single-family detached houses; high-rise apartment buildings emitted almost twice as much per person as single-family detached homes (5.4 tons versus 2.9 tons of carbon dioxide per person per year). Low-rise apartments (up to three stories) emitted 2.1 tons per person. It is important to note that this study disaggregated the type of multifamily housing and that carbon dioxide emissions increased as the density of the apartment building increased (in height). This suggests that the density of the multifamily unit matters, not just the general class into which housing falls.

The results were different when dwelling units were compared without adjusting for the number of people living in them. The units in the Australian study and in Ewing and Rong are not directly comparable. The Australian study focused on projects within a single county, while Ewing and Rong examine countywide averages. Nevertheless, in the Australian study, mid-rise and low-rise structures, town houses, and villas emitted fewer total tons of carbon dioxide than single-family detached houses, a result consistent with Ewing and Rong. High rises, however, emitted 10.4 tons per dwelling unit per year compared with 9.0 tons for detached single-family homes. "The results of this multi-unit residential energy study point to general trends and instances of great variability in multi-unit residential buildings," conclude Myors, O'Leary, and Helstroom (2005, 116).

The Australian results have important implications for the recommendations made by Ewing and Rong. On the surface, the type of density is important for understanding the environmental impact of development patterns, and on an aggregated level, the relationship between density and energy use/greenhouse gas emissions is *nonlinear* (U-shaped). Emissions are higher for very low density houses, fall for mid-density housing, and then increase for high-density housing. In addition, per capita emissions are higher for high-density projects than for low-density, detached dwellings even at mid-rise multifamily densities. Since detached houses tend to have larger households, the Australian data indicate that forcing larger households into higher-density housing is likely to *increase* per capita energy consumption and emissions. These kinds of variations are obscured when gross measures of geography such as county sprawl indices and general categorizations of housing are employed, but they may be critically important for urban design and land use policies.

Choice and market reforms versus administrative mandates

Perhaps as a reflection of the alarmist case for reducing energy use noted earlier, Ewing and Rong recommend administrative mandates—bureaucratic rules aimed at specific outcomes (mixed-use development, higher densities, etc.)—for changing urban form and largely ignore policy recommendations that might preserve choice while also encouraging energy conservation. This is understandable, since Ewing's research in particular is well known for its advocacy of compact, dense urban forms and its criticism of low-density development patterns. Policy recommendations that embrace choice would also embrace diversity in expressing that choice and eschew administrative mandates for certain land use outcomes. If one outcome is clearly considered inferior (in this case, low-density residential development), policy recommendations will not encourage consumer-based decisions influenced by supply and demand and will instead recommend top-down policies that prescribe specific outcomes. Policies that prescribe outcomes are better suited to administrative implementation because goals are not intended to meet customer preferences or demands.

However, administrative approaches to regulating energy use through growth controls are at best an indirect way to encourage conservation. If, for example, density is achieved by forcing households out of more energy-efficient newer homes and into less energy-efficient older homes—a result consistent with the Australian evidence on moving from very low density to high-density living—the results could be more energy use. Further, as mentioned earlier, the remedies proposed by Ewing and Rong focus primarily on limiting lower-density housing despite a demonstrated preference for this type by large segments of the U.S. population (and the world). (See the discussion in Bruegmann 2005 and Cox 2006.) Thus, growth management policies that truncate the housing market by limiting choice at the lower-density end of the housing ladder are needlessly restrictive.

Ewing and Rong's failure to recognize market forces in the energy arena and market-oriented alternatives to stringent land use controls may compromise policy makers' ability to achieve the straightforward and laudable goal of promoting innovation and energy conservation. Indeed, if Ewing and Rong are correct and natural resources are becoming scarcer (if we are reaching peak oil production), then energy prices will increase, prompting investment, research, and the development of alternatives. Some of these technologies (nuclear power) are relatively easy to apply, while others may require several decades of innovation to become economically viable (solar or wind power). Indeed, the primary barriers to nuclear power involve political, not engineering or safety, considerations. Moreover, rising energy prices have a direct impact on consumer and producer behavior, while land use policies are indirect and have diffused incentives and impacts. One of the most straightforward and effective market-based reforms would be to adopt marginal-cost pricing for resources—the price increases as the amount consumed increases. Many municipally run (or regulated) utilities use flat rates (dollars per kilowatt or gallon consumed), regardless of the amount. Ewing and Rong have not considered the implications of improved energy efficiency on their policy conclusions.

Conclusion

In sum, while Ewing and Rong have provided some empirical support for the view that different types of land uses and housing patterns influence current energy use, their analysis provides little guidance for policy makers or planners because it fails to consider how technology, the pace of innovation, or the specific character of the landscape or project influences energy use. Ewing and Rong provide a snapshot of current patterns and the environment without considering the dynamic aspects of markets or consumer behavior. Yet growth controls are implemented in a dynamic market economy where innovation shapes the demand for all sorts of products, including energy and the sources of energy production, every day. Their recommendations for using land use and growth management policies to promote energy conservation are akin to depending on the proverbial sledgehammer to pound a four-inch nail. Given the choice-limiting implications of the recommendations Ewing and Rong make and their systematic failure to consider the effects of technological innovation on their policy implications, policy makers and urban planners would be better served by choice-preserving market-based alternatives such as marginal-cost pricing. Indeed, these policy approaches would be more consistent with the way societies and economies have historically adapted to scarce resources.

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References

Australia Conservation Foundation. 2007. *Consumer Australia: Main Findings*. World Wide Web page <http://www.acfonline.org.au> (accessed January 12, 2008).

Avery, Dennis, and Fred Singer. 2007. *Unstoppable Global Warming: Every 1,500 Years*. Lanham, MD: Rowman & Littlefield.

Bradley, Robert Jr., and Robert Fulmer. 2004. *Energy: The Master Resource*. Dubuque, IA: Kendall/Hunt.

Bruegmann, Robert. 2005. *Sprawl: A Compact History*. Chicago: University of Chicago Press.

Cox, Wendell. 2006. *War on the Dream: How Anti-Sprawl Policy Threatens the Quality of Life*. New York: iUniverse.

Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: The Physical Science Basis. Summary for Policy Makers*. Geneva: IPCC Secretariat.

J. D. Power and Associates. 2007. Hybrid Vehicle Sales on Pace to Reach Record Sales in 2007. Press release, August 2. Westlake Village, CA.

Lomberg, Bjorn. 2007. *Cool It: The Skeptical Environmentalist's Guide to Global Warming*. New York: Knopf.

Mildner, Gerard C. S. 2001. Regionalism and the Growth Management Movement. In *Smarter Growth: Market-Based Strategies for Land-Use Planning in the 21st Century*, ed. Randall G. Holcombe and Samuel R. Staley, 95–112. Westport, CT: Greenwood.

Myors, Paul, Rachel O'Leary, and Rob Helstroom. 2005. Multi-Unit Residential Building Energy & Peak Demand Study. *Energy News* 23(4):113–16.

Office of the Mayor. n.d. *New York City Mobility Needs Assessment 2007–2030*. World Wide Web page <http://www.nyc.gov/html/planyc2030/downloads/pdf/tech_report_transportation.pdf> (accessed January 12, 2008).

Pisarski, Alan. 2007. *Commuting in America III*. Washington, DC: Transportation Research Board.

Spencer, Jack, and Nicolas Loris. 2007. *Dispelling Myths about Nuclear Energy*. Backgrounder No. 2087. Washington, DC: Heritage Foundation.

Staley, Samuel R. 2006. Sustainable Development in American Planning: A Critical Appraisal. *Town Planning Review* 77(1):99–126.

Staley, Samuel R., Jefferson Edgens, and Gerard Mildner. 1999. *A Line in the Land: Urban Growth Boundaries, Smart Growth, and Housing Affordability*. Policy Study No. 263. Los Angeles: Reason Foundation. World Wide Web page <http://www.reason.org/ps263.html> (accessed January 12, 2008).

U.S. Bureau of the Census. 2000. *Census 2000, Summary File 1*. World Wide Web page <http://factfinder.census.gov/servlet/GCTTable?_bm=y&ds_name=DEC_2000_SF1_U&-CONTEXT=gct&-mt_name=DEC_2000_SF1_U_GCTPH1_US9&-redoLog=false&-_caller=geoselect&-geo_id=&-format=US-25|US-25S&-_lang=en> (accessed January 12, 2008).

U.S. Energy Information Administration. 2007. *Annual Energy Review 2006*. Washington, DC.