Chapter VI. Energy Intensity in Appalachia

Understanding energy use patterns at the local level is a critical part of evaluating policy innovations directed at altering energy use among individuals and firms. Unfortunately, local energy use patterns must be estimated from more aggregated state level data. To do so, the study team estimated several measures of state level energy use in a series of models which account for the dominant determinants of energy use.

Two of the most common measures of energy intensity are total energy consumption per capita and per unit of personal income. The study team estimated per capita energy use as a function of personal income, average electricity prices, manufacturing's share of employment income, average annual temperature spreads and the proportion of a county living in urban areas. We also employed a statistical technique that permitted the capture of unobserved variables to be accounted for in our model. We tested this model on a panel of the lower 48 U.S. states from 2000 to 2004.

National and state-level energy intensity is shown in Table 6.1 below. Five of the Appalachian states have lower than average state-wide energy use per capita. These states are more urban than the other eight states and energy use is undoubtedly weighted toward the urban areas which are not in the Appalachian region. Eight of the states have above-average energy use per capita.

Table 6.1: State and National Energy Intensity

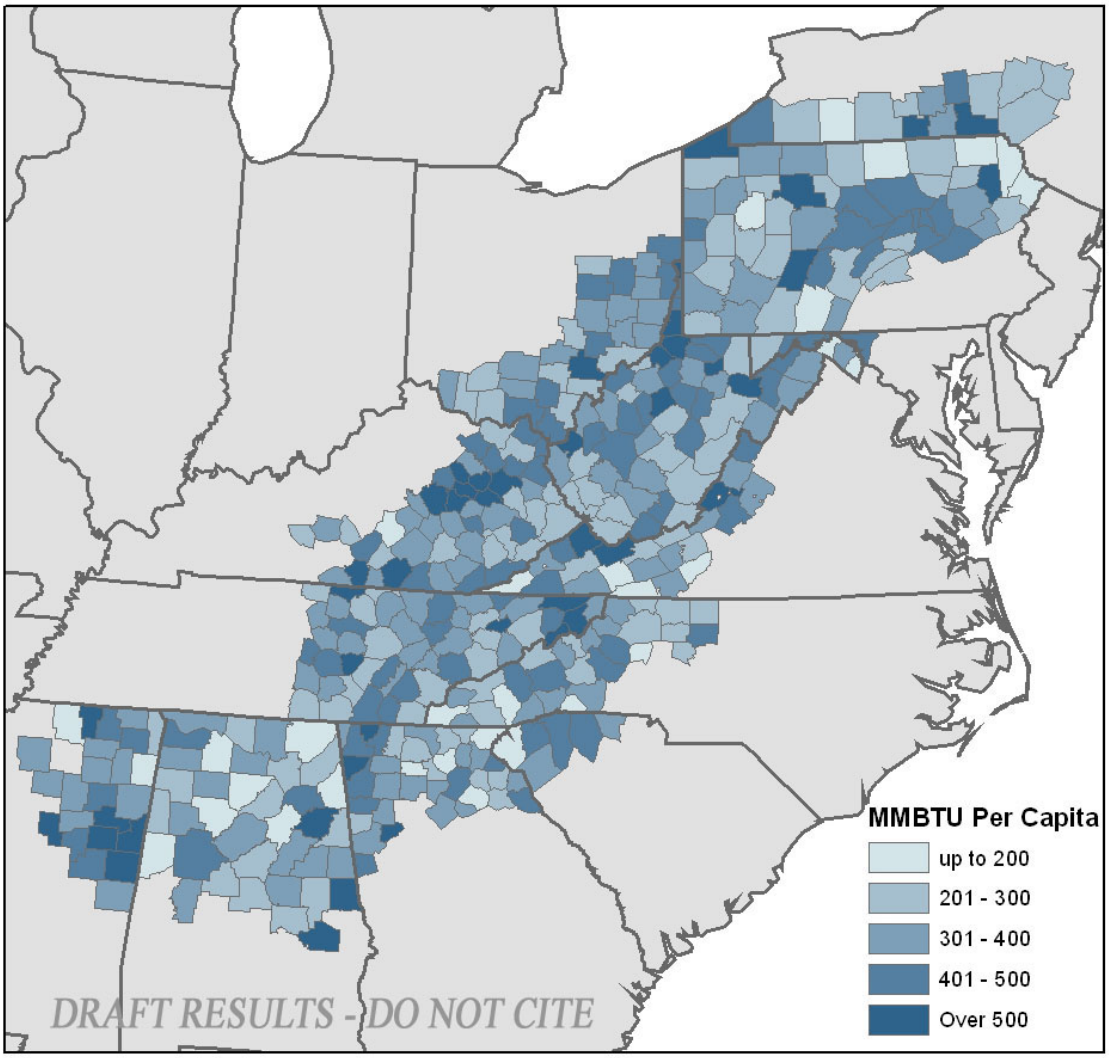
STATE	MMbtu/Capita	Mmbtu/$1000 Personal Income
New York	218	5.6
Maryland	268	6.4
Pennsylvania	319	9.5
North Carolina	322	10.3
Virginia	327	8.6
Ohio	351	11.2
Georgia	352	10.8
Tennessee	386	12.5
South Carolina	386	13.6
Mississippi	412	16.5
West Virginia	421	16.3
Alabama	437	15.5
Kentucky	465	16.6
United States	**338**	**11.0**

1. Energy Consumption Per Capita

State-wide statistical results were applied to county-specific data within the Appalachian region to estimate county-level energy intensity. Figure 6.1 presents estimated per capita energy consumption. These results show broad dispersion in per capita energy use, with manufacturing and population density having important effects. The overall region is very close to the national average per capita energy use. However, this is dominated by energy use trends in the heavily urban states of New York and Maryland. As shown above, most states have above-average consumption rates. This is likely due to high rates of electrification in some states, which may increase overall energy use, and a somewhat elevated share of manufacturing; the ARC counties account for about 26 percent of manufacturing income in the ARC states, but only 24.5 percent of the population.

At the county level, estimates of energy use per capita can are strongly influenced by the relative proportion of energy-intensive manufacturing to population. A sparsely populated county with a heavy industry present will have high per capita energy consumption. Conversely, urban counties with modest manufacturing presence may have low to average rates of energy consumption due to the more efficient residential use of energy in densely populated areas.

Figure 6.1: Estimated Per Capita Energy Intensity in Appalachia (MMBtu per Capita)

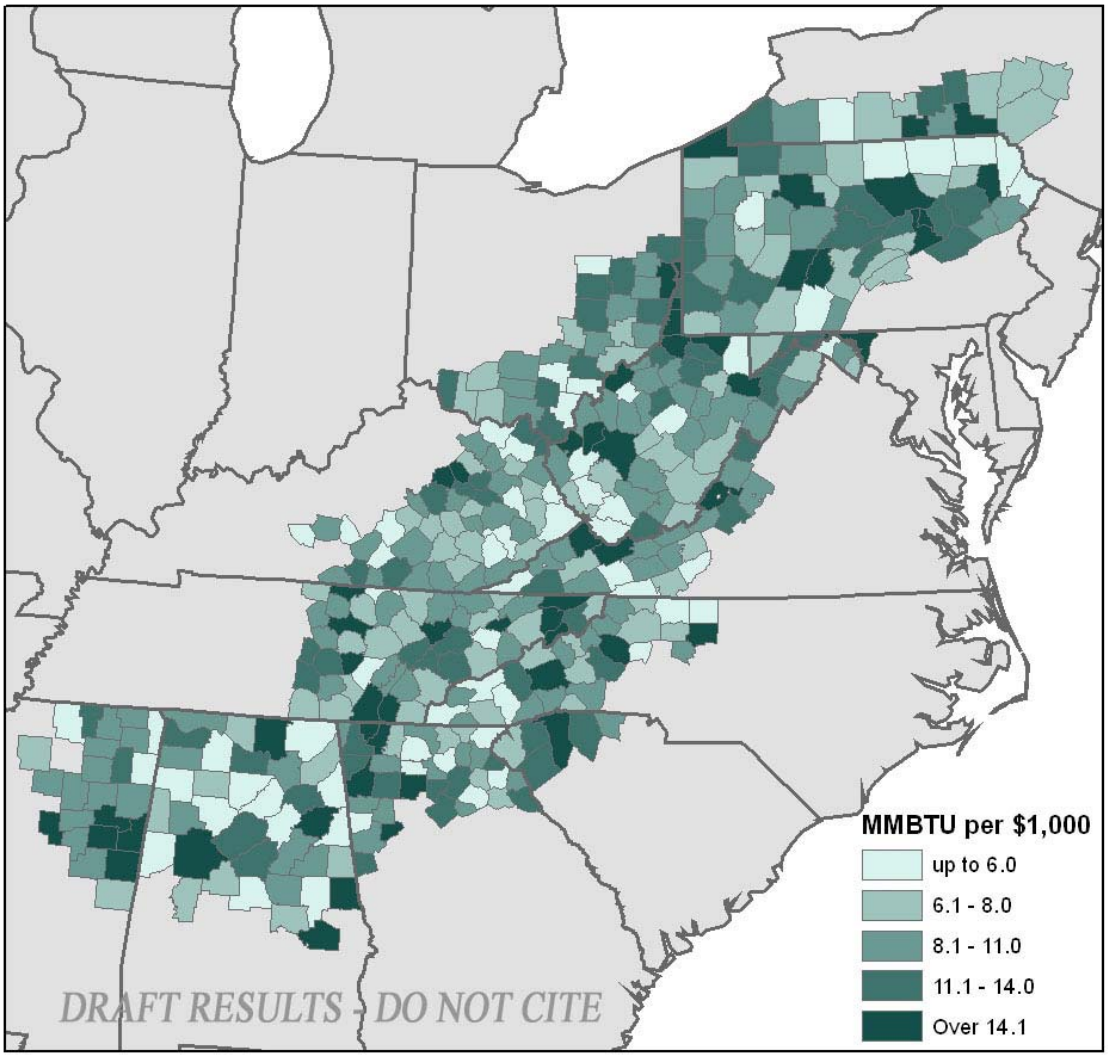


2. Energy Consumption Per Unit of Personal Income

Estimates of total energy use per dollar of personal income are shown in Figure 6.2. This is a county level measure of the energy intensity per dollar of economic activity. Again, the findings show that total energy use per dollar of personal income is heavily affected by industrial use and population density.

This measure of energy intensity also varies considerably by county. Economically distressed and at-risk counties with low personal income and little manufacturing will show below average consumption per unit of income, while those same counties with a single heavy manufacturing facility may be above-average consumers due to the dominance of that facility and the sparse population.

Figure 6.2: Estimated Economic Energy Intensity in Appalachia
(MMBtu per $1000 personal income)



3. Energy Demand Price Response

The responsiveness of residents and businesses to energy prices in another important policy consideration. In an effort to understand how policy innovations may alter use of energy, the price elasticity of demand for electricity for residential, commercial and industrial consumers in the Appalachian states was estimated by comparing price and demand trends from 2000 through 2004. The price elasticity of demand is formally the percentage change in quantity demanded when there is a one percent change in the price. These types of estimates are the stock in trade of economic analysis for more than a century. The results shown in Table 6.2 show that consumers of electricity are not very price responsive.

Table 6.2: Price Elasticity of Demand for Electricity in Appalachia

Residential Users	-0.15
Commercial Users	-0.17
Industrial Users	-0.55

The results of this estimate reaffirm a familiar belief among economists regarding price responsiveness of firms and consumers towards electricity use. In the short run electricity users are fairly price insensitive, and that this is especially true for residential and commercial users. These users are not likely to trade in appliances just because energy prices have increased. This is intuitively appealing since residential users tend to spend a small proportion of their total incomes on electricity, thus price fluctuations tend not to cause large changes in consumption. Further, since prices are dependent on factors that are local, both input costs and public utility pricing policies, they tend to change infrequently. This same argument is also true for commercial users, whose electricity costs are a relatively small share of their total production costs. In these cases, the capital costs of adopting new technologies may not be covered by the energy savings until the very long run.

Industrial users, who may bear very high energy costs, tend to be more price responsive than commercial users, and this may influence firm location decisions. This is especially true since industrial users are somewhat more flexible in their location decisions, as their sales are less tied to proximal population centers.

The policy insight garnered from this evidence is useful. For example, fiscal efforts to alter the effective price of electricity will have far more modest impacts on residential users than on industrial users. Policies to encourage installation of energy efficient or new technologies will not have very positive effects unless accompanied by heavy subsidization and education. On the other hand, energy audits which demonstrate how energy can be saved in industrial processes have positive results, as indicated elsewhere in the report.

4. Summary

Appalachian energy intensity is somewhat higher than in other areas of the country. Price, temperature variation, manufacturing share of employment and the degree of urban residences all matter in formulating both energy intensity and overall use. Appalachian residents and businesses are, like their counterparts in other regions, relatively unresponsive to electricity price changes in the short run. This thus provides some evidence of the magnitude of policy changes needed to alter short run use of energy.

Appendix A: Wal-Mart and Alternative Fueled Vehicles – The Role of the Private Sector

Public sector efforts to spur alternative fuel use will necessarily be limited to the fiscal and regulatory instruments wielded by governments. Ultimately, these efforts will lead to changes in the private sector that are consistent with profit maximizing efforts by firms. One clear example is in the evolution of alternative fueled vehicle (AFV) adoption by consumers.

In 2005, the Center for Business and Economic Research evaluated the economic alternatives related to location of a FutureGen facility in which AFVs were examined. This study performed a detailed analysis of the role incomes, population concentration, gasoline and alternative fuel prices, state and federal gasoline taxes and state tax incentives played on adoption rates of AFVs. Among the policy relevant findings were that state and federal gasoline tax rates and state tax incentives for AFVs played an important role in the adoption of the new technology. However, even with extensive tax incentives, per capita rates of AFV usage are quite low. For example, while the study found that extending or strengthening these incentives would, in some instances, double the AFV usage rates, this translated into perhaps a few hundred to at most a few thousand additional vehicles in most states.

The authors attribute this disappointing result to the widespread absence of refueling facilities, both in Appalachia and nationwide. Thus the absence of an AFV fueling network may well then dampen the effectiveness of public policy. Happily, a recent announcement by Wal-Mart, that it is considering locating AFV fueling stations at many of its stores potentially changes dramatically the network availability of AFV fueling stations. To illustrate this, compare the two accompanying figures.

Figure A.1 employs data from the Energy Information Administration showing AFV fueling stations currently located in Appalachia. The relative paucity of stations and their clustering in urban areas clearly presents the problem. Figure A.2 illustrates the Wal-Mart and Super Center locations in Appalachia. The introduction of AFV fueling facilities in even 50 percent of these locations would dramatically extend the network of AFV fuel. This extension would, at the very least, better enable public policy efforts to promote alternative fuel use in the region.

Figure A.1: Location of Current Alternative Fuel Stations in Appalachia

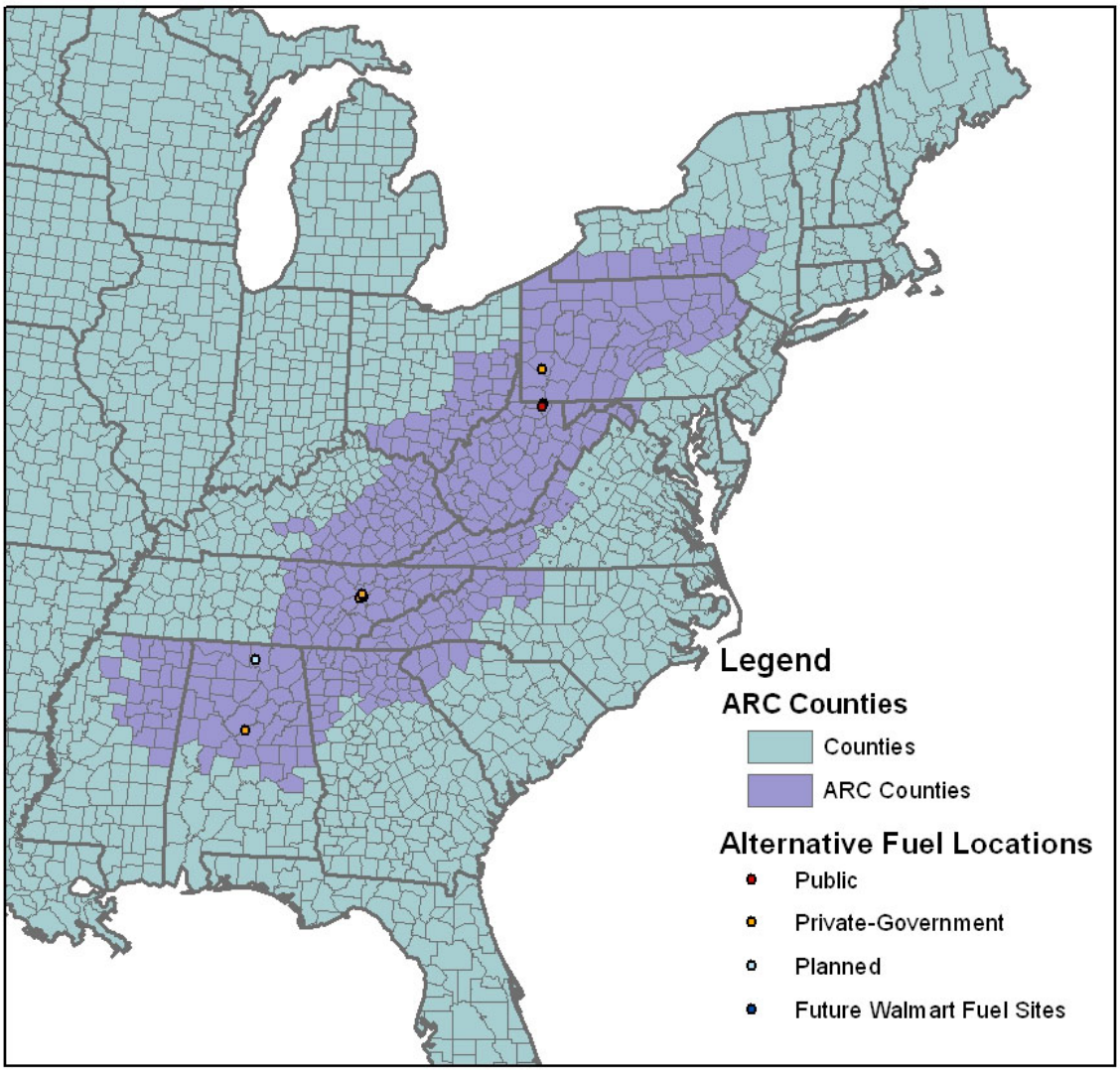
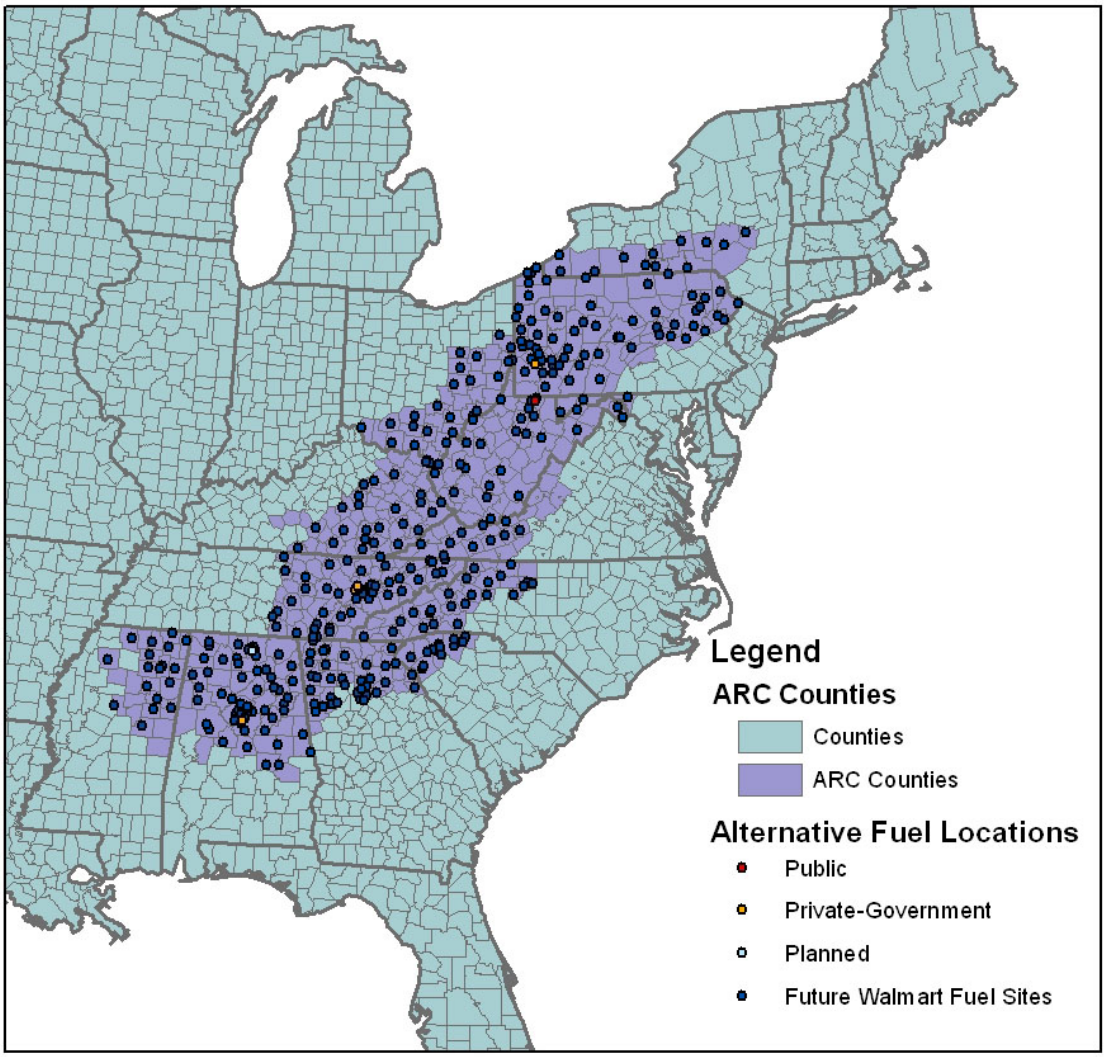



Figure A.2: Location of Potential Wal-Mart Alternative Fuel Stations in Appalachia