



NICHOLAS INSTITUTE  
FOR ENVIRONMENTAL POLICY SOLUTIONS  
DUKE UNIVERSITY

# ENERGY EFFICIENCY IN THE SOUTH

## APPENDIX G

### STATE PROFILES OF ENERGY EFFICIENCY OPPORTUNITIES IN THE SOUTH: TENNESSEE

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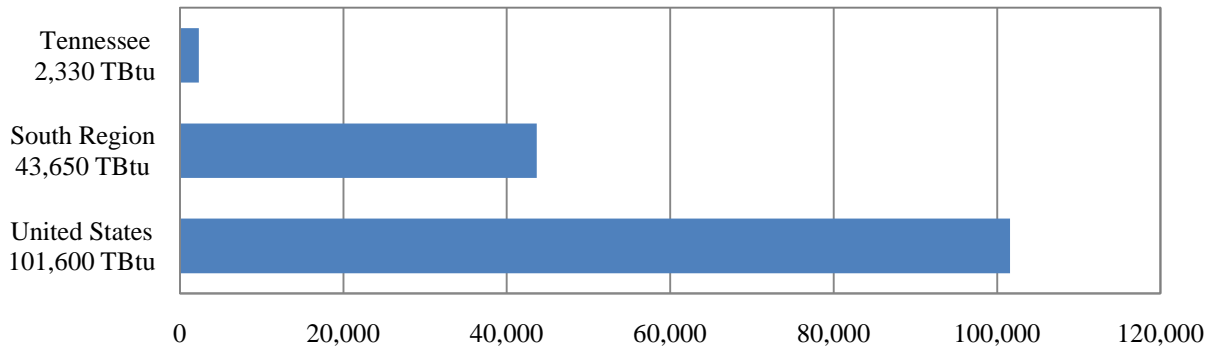
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## A Profile of Energy-Efficiency Opportunities in Tennessee

The economic recession, climate change concerns and rising electricity costs have motivated many states to embrace energy efficiency as a way to create new local jobs, lower energy bills and promote environmental sustainability. With this surge of interest in energy efficiency, policymakers are asking: “how much energy can be saved?” This profile characterizes the opportunity for cost-effective energy-efficiency improvements in the residential, commercial and industrial sectors of Tennessee. It draws on the results of a study of *Energy Efficiency in the South* conducted by a team of researchers at the Georgia Institute of Technology and Duke University. The study presents primary and in-depth research of the potential for energy-efficiency improvements, using a modeling approach based on the SNUG-NEMS (National Energy Modeling System).<sup>1</sup>

With a population of 6.3 million people<sup>2</sup>, the State represents about 2.1% of the U.S. population, 1.8% of the nation’s Gross Domestic Product (GDP), and 2.3% of U.S. energy consumption (Figure 1).<sup>3</sup> Thus, compared to the rest of the nation, Tennessee has a higher-than-average level of energy intensity (that is, it consumes more energy per dollar of economic activity than most other states).

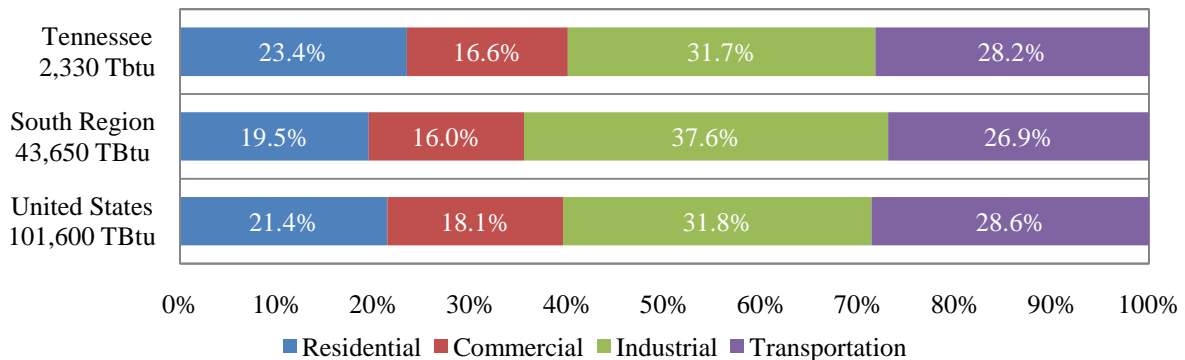


**Figure 1: Energy Consumption in Tennessee, the South, and the U.S., 2007**

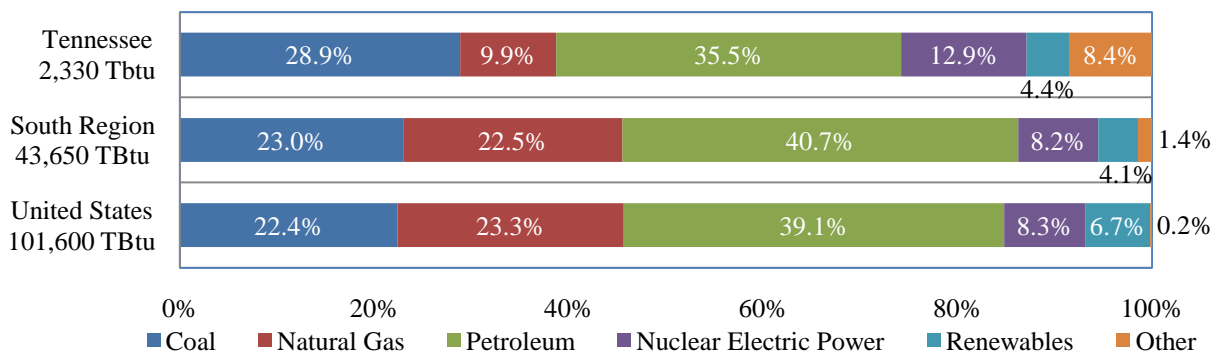
Unlike most states in the South that account for a disproportionately large amount of the nation’s industrial energy use, industry accounts for only 32% of Tennessee’s overall energy consumption. In contrast, its residential energy consumption as a percentage of its overall energy use exceeds that of the South and that of the nation (Figure 2).

Tennessee consumes proportionately more coal and nuclear energy than other states in the South. On the other hand, it consumes relatively less natural gas and petroleum (Figure 3). The federally administered Tennessee Valley Authority (TVA) controls nearly all of the state’s electricity generation. It generates more electricity than any other public utility in the nation.

About 64 percent of the electricity consumed in Tennessee is generated by coal plants, and approximately 27% is generated by nuclear plants.



**Figure 2: Energy Consumption in Tennessee, the South, and the U.S. by Sector, 2007**



**Figure 3: Energy Consumption in Tennessee, the South, and the U.S. by Fuel Type, 2007**

Tennessee is also home to one of the largest Department of Energy energy efficiency programs at Oak Ridge National Laboratory (ORNL). By partnering with ORNL, TVA and the Tennessee State Energy Office have helped to test and demonstrate advanced energy technologies including a collection of near net-zero energy Habitat for Humanity homes in Lenoir City.

Tennessee already has a number of energy efficiency policies in place. For instance, the Tennessee Clean Energy Future Act passed by the General Assembly in 2009 focuses on having states lead by example, encouraging the growth of clean jobs, and promoting greater energy efficiency in the residential sector. The legislation includes launching a five-year accelerated program to improve energy efficiency in state buildings, establishing a statewide residential building code, and expanding eligibility for federal funds used to weatherize existing homes in low-income areas. Several programs offer assistance for small business energy efficiency projects, including low-interest loans, and free energy audits. More state initiatives are described in recent Southern States Energy Board and National Association of State Energy Officials publications.<sup>4, 5</sup>

Nevertheless, the *2009 State Energy Efficiency Scorecard* from the American Council for an Energy Efficient Economy (and other studies of the State and region) suggests that additional policy initiatives are needed in the State to encourage households, businesses, and industries to utilize energy more effectively. Specifically, the ACEEE study rated Tennessee 38th of the 50 states and DC for its adoption and implementation of energy-efficiency policies. This score is based on the state’s performance in six energy efficiency policy areas: utility and public benefits, transportation, building energy codes, combined heat and power, state government initiatives, and appliance efficiency standards.<sup>6</sup>

In the *Meta-Review of Efficiency Potential Studies and Their Implications for the South*, Chandler and Brown (2009) reviewed six energy-efficiency studies that covered Tennessee. According to this meta-review, estimates of “maximum achievable” potential energy savings range from 14-26% of projected energy consumption in 2020. Tennessee’s energy-efficiency potential would be higher than this range with the implementation of all cost-effective opportunities, but the number of studies with such estimates is limited.<sup>7</sup>

### Energy Efficiency Potential by Sector

The State’s total energy consumption (residential, commercial, industrial, and transportation sectors) is projected to increase 15% from 2010 to 2030. This profile describes the ability of nine energy policies to accelerate the adoption of cost-effective energy-efficient technologies in the residential, commercial, and industrial sectors of Tennessee. Altogether, these policies offer the potential to reduce Tennessee’s energy consumption by approximately 11% of the energy consumed by the State in 2007 (260 TBtu in 2030) (Figure 4). With these policies, Tennessee’s projected energy consumption could remain level through 2015, after which a modest growth in demand would occur. For complete policy descriptions, refer to *Energy Efficiency in the South* by Brown et al. (2010).

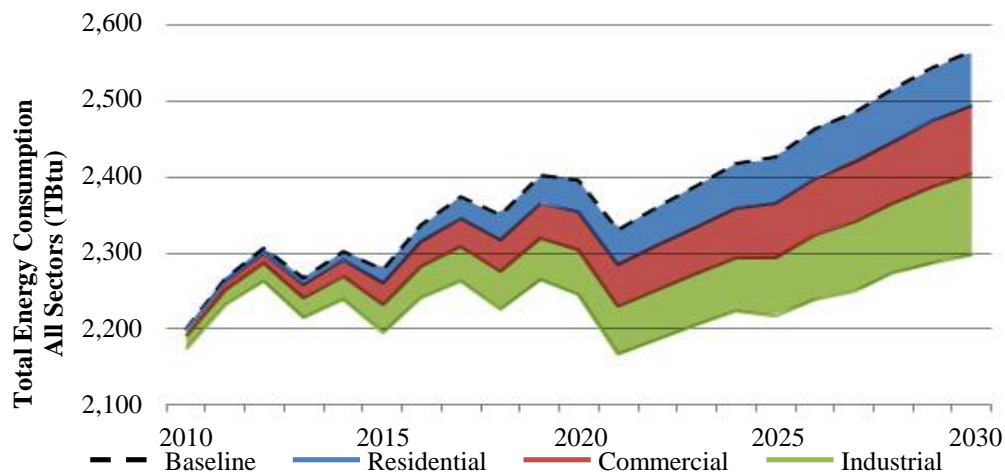
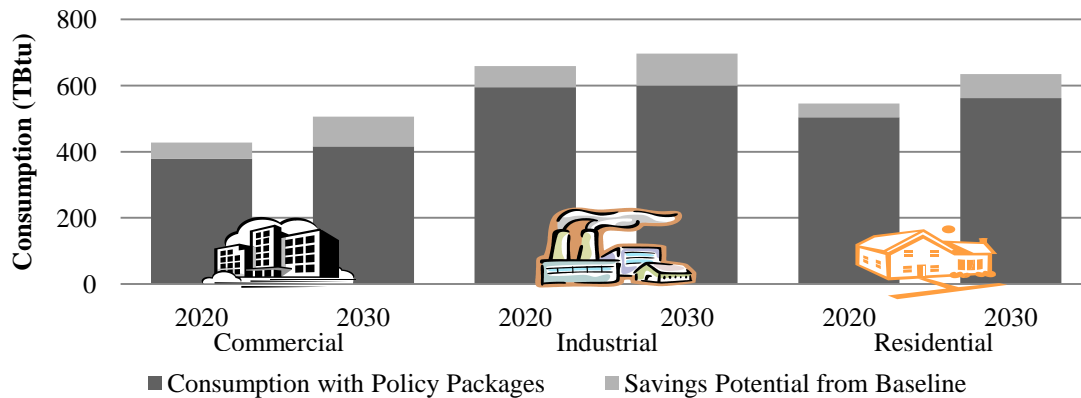


Figure 4: Energy Efficiency Potential in Tennessee<sup>16</sup>

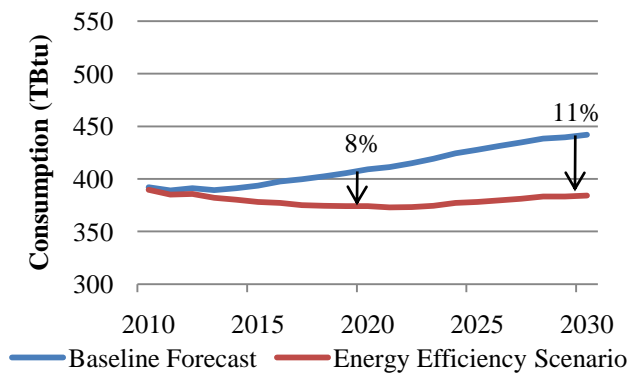
Each of the three sectors offers approximately equal levels of energy efficiency potential in Tennessee (Figure 5). In 2020, savings from all three sectors is about 7% (150 TBtu) of the total energy consumed by the State in 2007. Electricity savings are about 140 TBtu of this amount. The energy efficiency savings from the three sectors decrease the total projected consumption for the state by 7% in 2020 and 10% in 2030. With these policies, the electricity generated by four 500-MW power plants in 2020 and seven such power plants in 2030 could be avoided.<sup>8</sup>



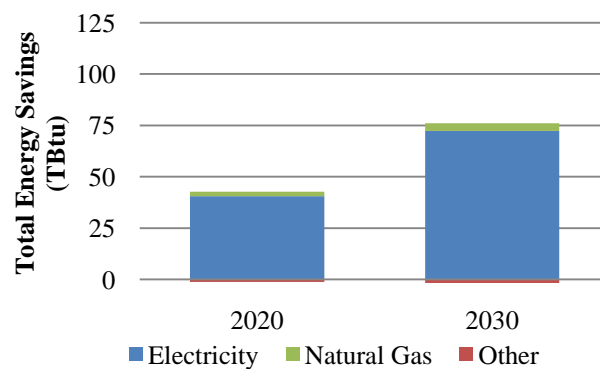
**Figure 5: Energy-Efficiency Potential by Sector in Tennessee, 2020 and 2030**

### ***Residential Sector***

Four residential energy efficiency policies were examined: more stringent building codes with third party verification, improved appliance standards and incentives, expanding the Weatherization Assistance Program, and retrofit incentives with increased equipment standards. Their implementation could reduce Tennessee’s projected residential consumption by about 8% (41 TBtu) in 2020 and 11% (72 TBtu) in 2030 (Figure 6).



**Figure 6: Residential Sector Savings**

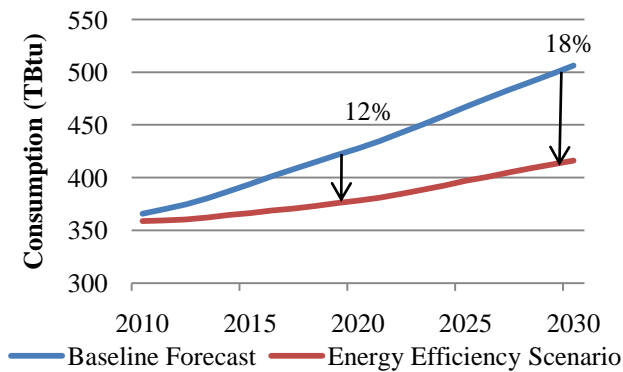


**Figure 7: Residential Sector Savings by Fuel Type**

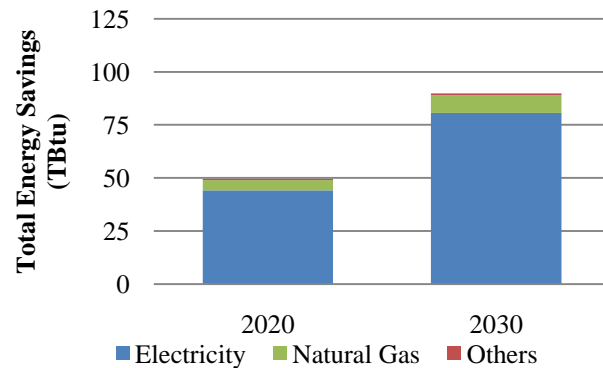
In 2020, the residential energy required by about 180,000 Tennessean households could be avoided or about \$260 per household. The principal energy savings are from electricity (Figure 7). With these policies, residential energy consumption could remain largely unchanged over the next decade, and grow more gradually than the baseline forecast in the following decade.

### ***Commercial Sector***

The implementation of appliance standards and retrofit policies in Tennessee’s commercial sector could reduce projected energy consumption in 2020 by about 12% (50 TBtu), and by about 18% (90 TBtu) in 2030 (Figure 8). In 2020, the commercial sector could save about 90 TBtu, which is equivalent to the amount of energy that 1,400 Wal-Mart stores spend a year. Each retail establishment in Tennessee could save about \$20,000 on average.<sup>9</sup> The principal energy savings are from electricity, with natural gas and other fuels providing additional savings (Figure 9). The rapid growth of commercial energy consumption forecast for Tennessee could be constrained to only modest growth with these two energy efficiency policies.



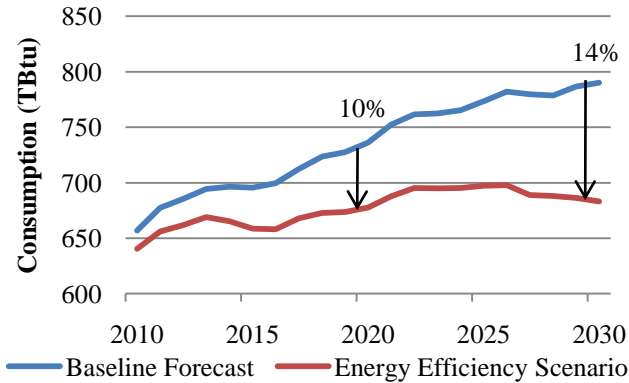
**Figure 8: Commercial Sector Savings**



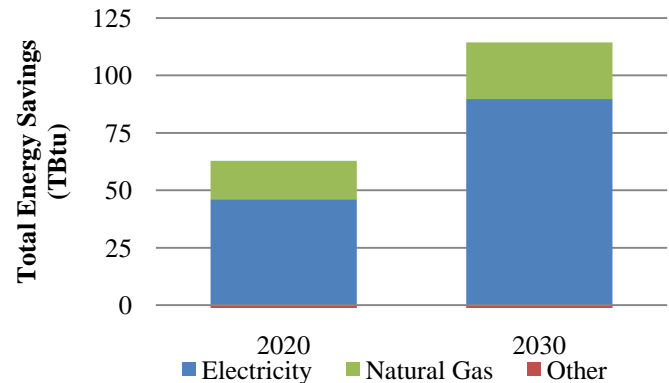
**Figure 9: Commercial Sector Savings by Fuel Type**

### ***Industrial Sector***

The implementation of plant utility upgrades, process improvements, and combined heat and power policies in Tennessee’s industrial sector can reduce projected consumption by about 10% (63 TBtu) in 2020 and 14% (97 TBtu) in 2030 (Figure 10). The industrial energy required by about 91 average industrial facilities is avoided in 2020, or about \$73,000 average annual savings per industrial facility. The principal energy savings are from electricity, but significant natural gas savings could also occur (Figure 11). These three energy efficiency policies could nearly eliminate any growth in consumption of industrial energy over the next two decades.



**Figure 10: Industrial Sector Savings**



**Figure 11: Industrial Sector Savings by Fuel Type**

### Efficient Technology Opportunities

The projected energy-efficiency potential can be realized through an array of new and existing technologies. *Energy Efficiency in the South* describes a number of these.

Emerging residential products can provide greater energy savings without sacrificing performance. For instance, currently available heat pump water heaters can cut annual energy costs for water heating up to 62%.<sup>10</sup>

Opportunities for commercial energy efficiency may be obtained through technologies like the geothermal heat pump (ground-source heat pump), which can reduce energy consumption by up to 44% when compared to air-source heat pumps and by up to 72% when compared to electric resistance heating with standard air-conditioning equipment. Though the installation cost is higher, the long lifetime of 20-25 years ensures energy bill saving benefits over time.<sup>11</sup>

Super boilers, which represent over 95 percent fuel-to-steam efficiency, can be implemented in the industrial sector. This technology is able to improve heat transfer through the use of advanced firetubes with extended surfaces that help achieve a compact design through reducing size, weight, and footprint. The advanced heat recovery system combines compact economizers, a humidifying air heater, and a patented transport membrane condenser.<sup>12</sup>

These technologies are illustrative. Please refer to *Energy Efficiency in the South* by Brown et al. for additional technology descriptions and examples.

### Economic and Financial Impacts

The nine energy efficiency policies evaluated in *Energy Efficiency in the South* would reduce energy costs for Tennessee consumers and would generate jobs in the State (Table 1).

Residential, commercial and industrial consumers could benefit from total energy savings of \$1.6

billion in 2020 (\$1.1 billion of which is specific to electricity), and \$3.1 billion in total energy savings in 2030. In comparison, the State spent \$7.5 billion on electricity in 2007.<sup>13</sup>

Using an input-output calculation method from ACEEE – with state-specific impact coefficients and accounting for declines in employment in the electricity and natural gas sectors – we estimated that Tennessee would experience a net gain of 15,600 jobs in 2020, growing to 21,500 in 2030. In comparison, there were over 320,000 unemployed residents of Tennessee at the end of 2009.<sup>14</sup>

As is true for the South at large, the policies would also lead to an increase in Tennessee's economic activity. Specifically, its Gross State Product would increase by an estimated \$229 million in 2020 and by \$479 million in 2030. This change is a small fraction of Tennessee's \$209 billion economy.<sup>15</sup>

<b>Indicator</b>	<b>2020</b>	<b>2030</b>
Public Sector Policy Financial Incentives (in million \$2007)	528	853
Private Sector/Household Productive Investment (in million \$2007)	440	480
Change in Electricity Costs (in million \$2007)	-1,134	-2,228
Change in Natural Gas Costs (in million \$2007)	-\$404	-\$751
Annual Increased Employment (ACEEE Calculator)	15,600	21,500
Change in Gross State Product (in million \$2007)	229	479

### **Conclusions**

The energy efficiency policies described in this profile could set Tennessee on a course toward a more sustainable and prosperous energy future. If utilized effectively, the State's substantial energy-efficiency resources could reverse the long-term trend of ever-expanding energy consumption. With a sustained and concerted effort to use energy more wisely, Tennessee could grow its economy, created new job opportunities, and reduce its environmental footprints.

For more information on the methodology used to derive this state profile, please see *Energy Efficiency in the South*.<sup>1</sup>

### **Acknowledgements**

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