



Residential Efficiency Presentation

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Residential Working Group Process

- Governor Appoints Residential Working Group (7/16)
 - (Chair) Michael Vandenberg, Vanderbilt Law School
 - V. Lynn Evans, MLGW
 - Elizabeth Eason, U.S. Green Building Council
 - Phil Chamberlain, Home Builders Assoc. of TN
 - Emily Reynolds, TVA
- Working Group Process
 - Teleconferences
 - First WG meeting (7/29)
- Next Steps
 - Feedback today
 - WG continues to meet
 - Garner additional stakeholder and public input
 - Return to Taskforce with additional information at Sept. TF meeting and recommendations at Nov. TF meeting



Presentation Roadmap

- **Priority and Urgency of the Residential Sector**
 - Reasons to focus on the residential sector

- **Tennessee Residential Energy Facts**
 - An overview of TN energy use and housing characteristics (provided largely by TN Dept. of Economic and Community Development, and TVA)

- **Barriers**
 - Obstacles that must be overcome to effect change

- **Opportunities and Policy/Program Options**
 - How we can address the barriers and capture the opportunities



Priority and Urgency of the Residential Sector

■ Size

- The residential sector comprises ~40% of US energy consumption
- Buildings are 21.2% and transportation is 19.8%

■ Vulnerability

□ Buildings

- Natural gas and heating oil costs have risen sharply and will likely be high this winter
- TN per-capita residential electricity consumption is 1st or 2nd in U.S., and costs are rising
 - ~65% of TN electricity is generated from coal, as compared to 52% nationally (Source: EIA 2006)
 - When a price is put on carbon, the cost of coal-generated electricity will increase relative to other sources

□ Transportation

- Gasoline prices have increased dramatically in the last 2 years
- TN per-capita VMT is 10th highest in US and Nashville is second highest (Source: Tennessean 11/06/07)
- TN ranked 17th most vulnerable state based on percent of income spent on gas (Source: Gardiner & Associates 2008)
- Low rates of physical activity are associated with obesity and a wide range of adverse health effects

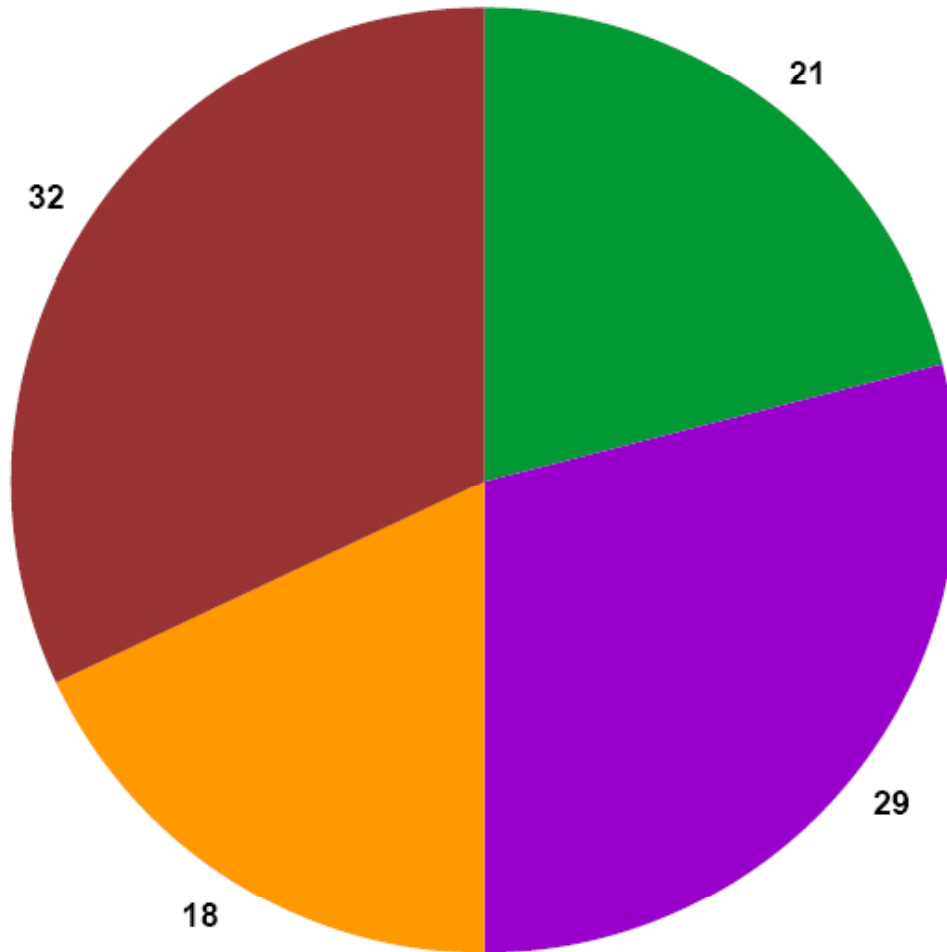
■ Opportunity

- The residential sector has many of the greatest opportunities for reducing energy use and generating large cost savings.
- Energy use reductions will yield co-benefits for health, air quality, and energy independence



Tennessee Residential Energy Facts

U.S. Energy Consumption by Sector, 2005



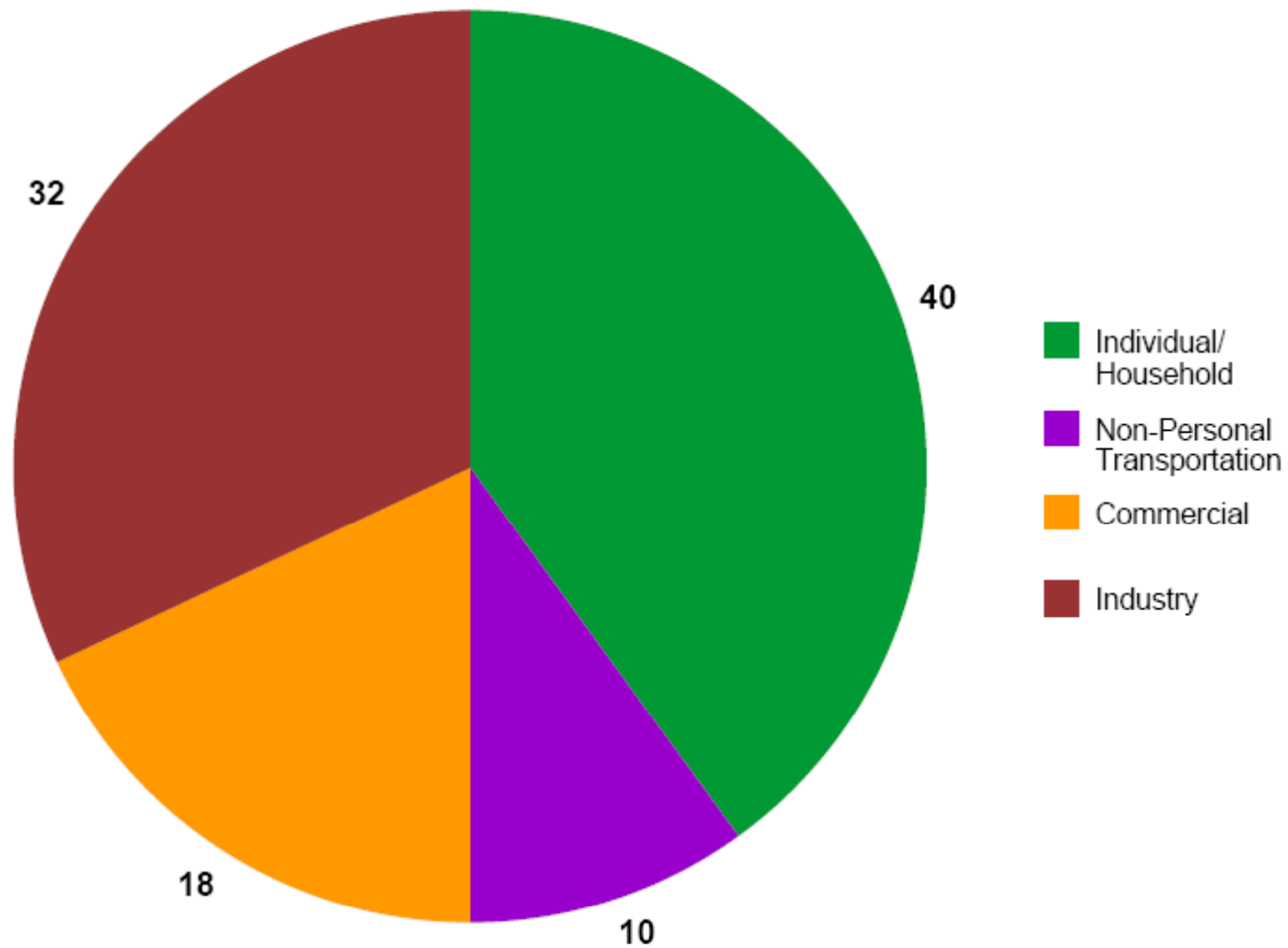
- Tennessee follows national averages for energy use in the four major sectors.
- Tennessee ranks 16th in total energy consumption per capita.



Gardner and Stern (2008)

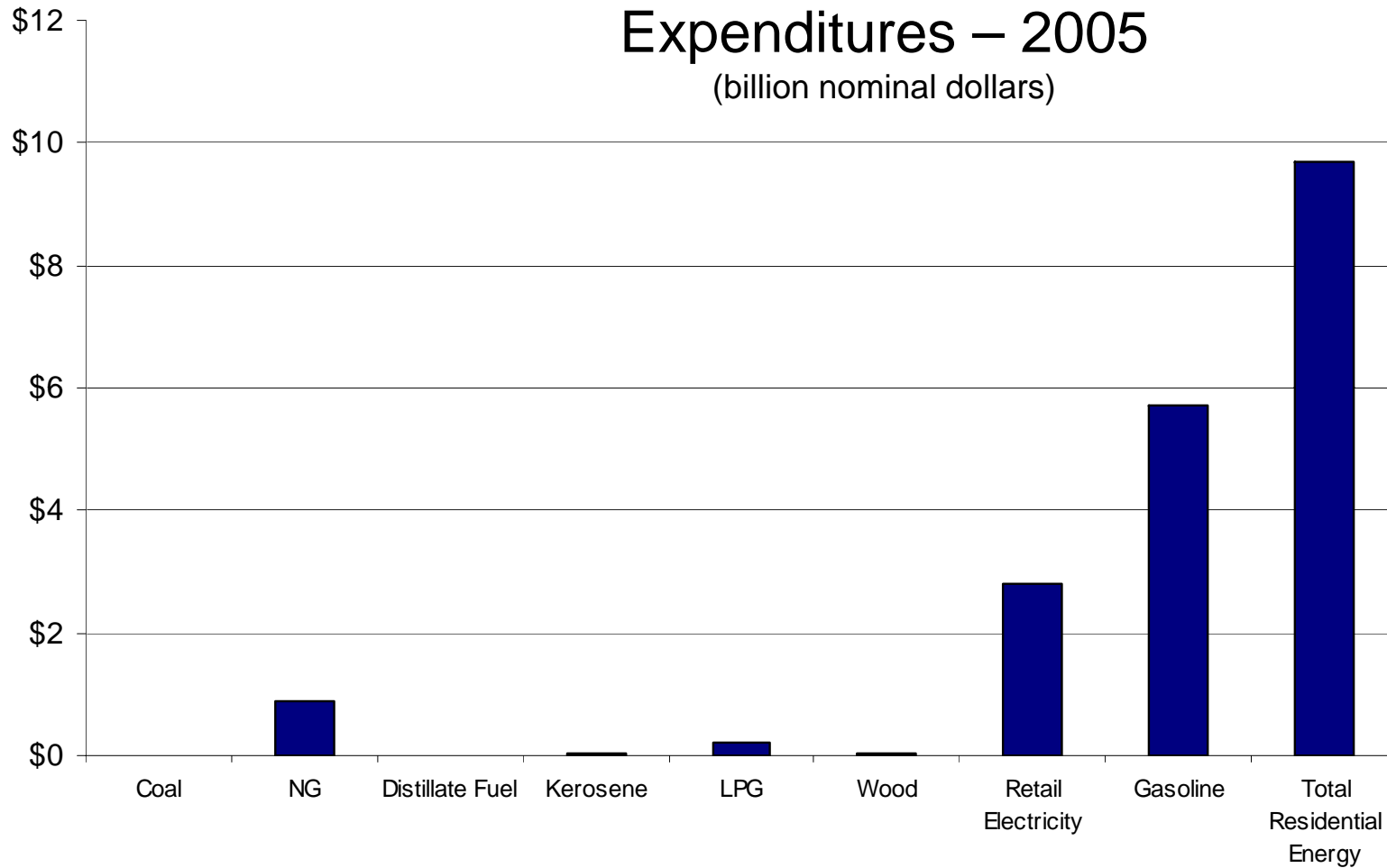
Source: Barkenbus, 2008 (based on EPA and DOE/ORNL data)

U.S. Energy Consumption by Modified Sector, 2005



Tennessee Residential Energy Expenditures – 2005

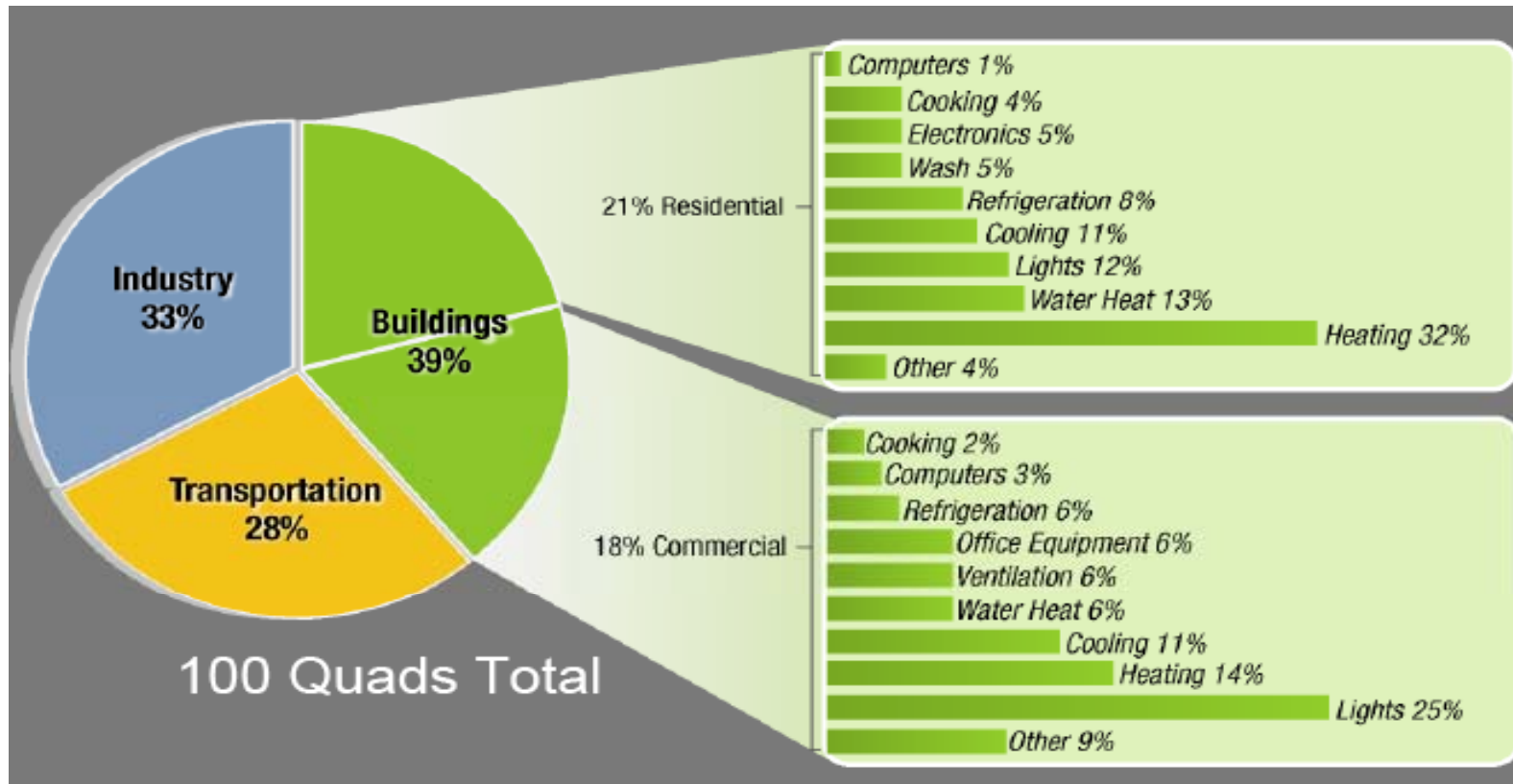
(billion nominal dollars)



- Gasoline adjusted to estimated 85% of EIA transportation data
- 2005 total energy expenditure for TN across all sectors and fuels was about \$22 billion

Sources: EIA Table 2. Residential Sector Energy Price and Expenditure Estimates, 1970-2005, Tennessee;
 EIA Table 5. Transportation Sector Energy Price and Expenditure Estimates, 1970-2005, Tennessee;
 EIA Table 1. Energy Price and Expenditure Estimates by Source, 1970-2005, Tennessee)

U.S. Energy Profile

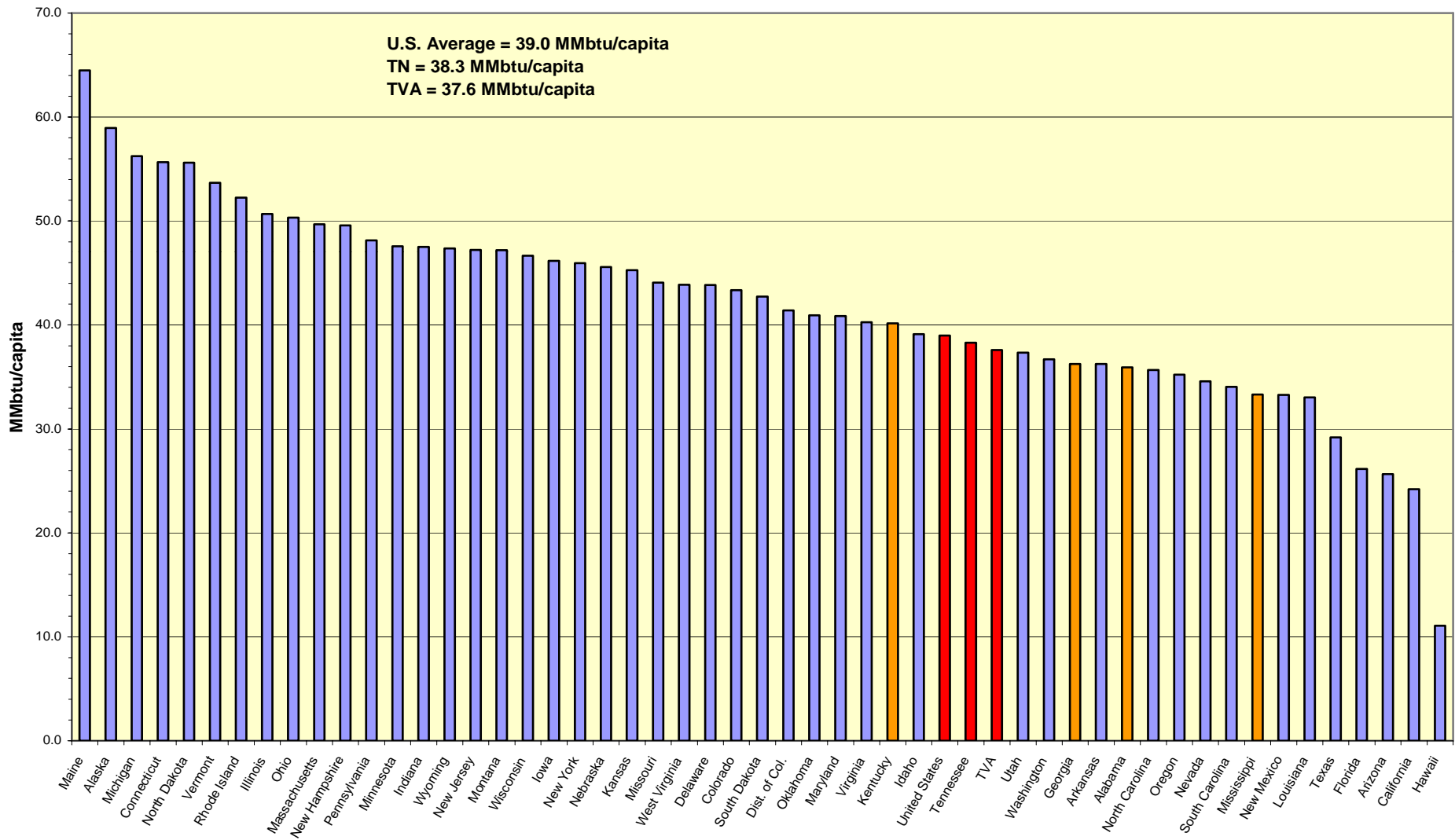


EIA National Data



Residential Building Energy Intensity – 2005

MMbtu/capita – All Energy Sources

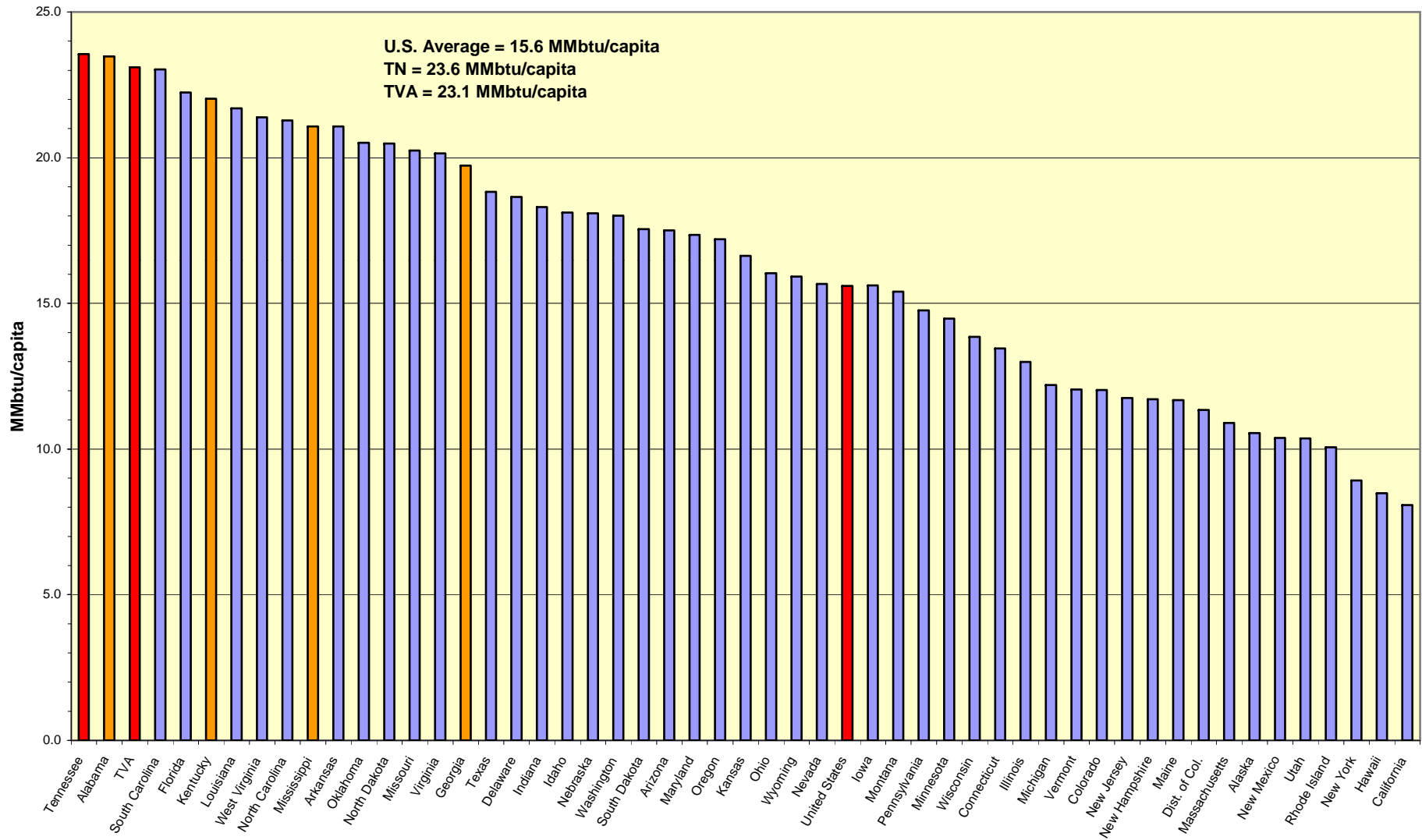


EIA National Data

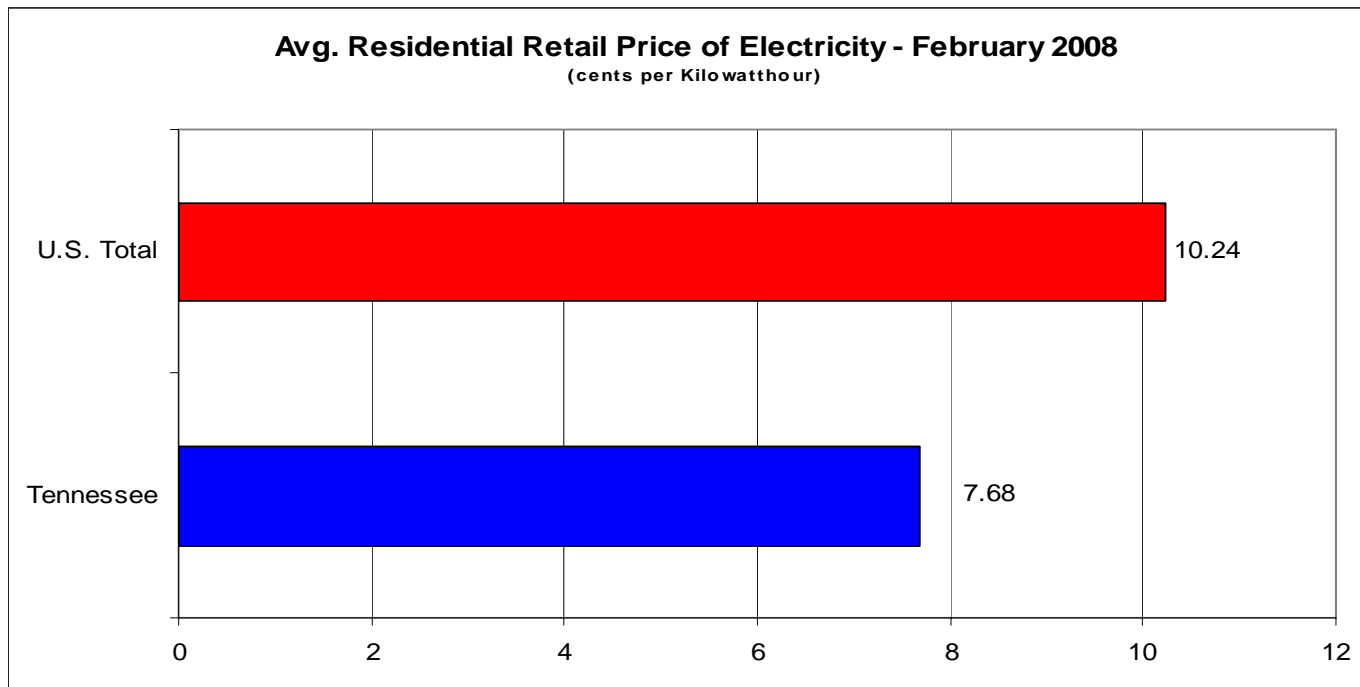


Residential Electricity Intensity - 2005

MMbtu/capita - Electricity

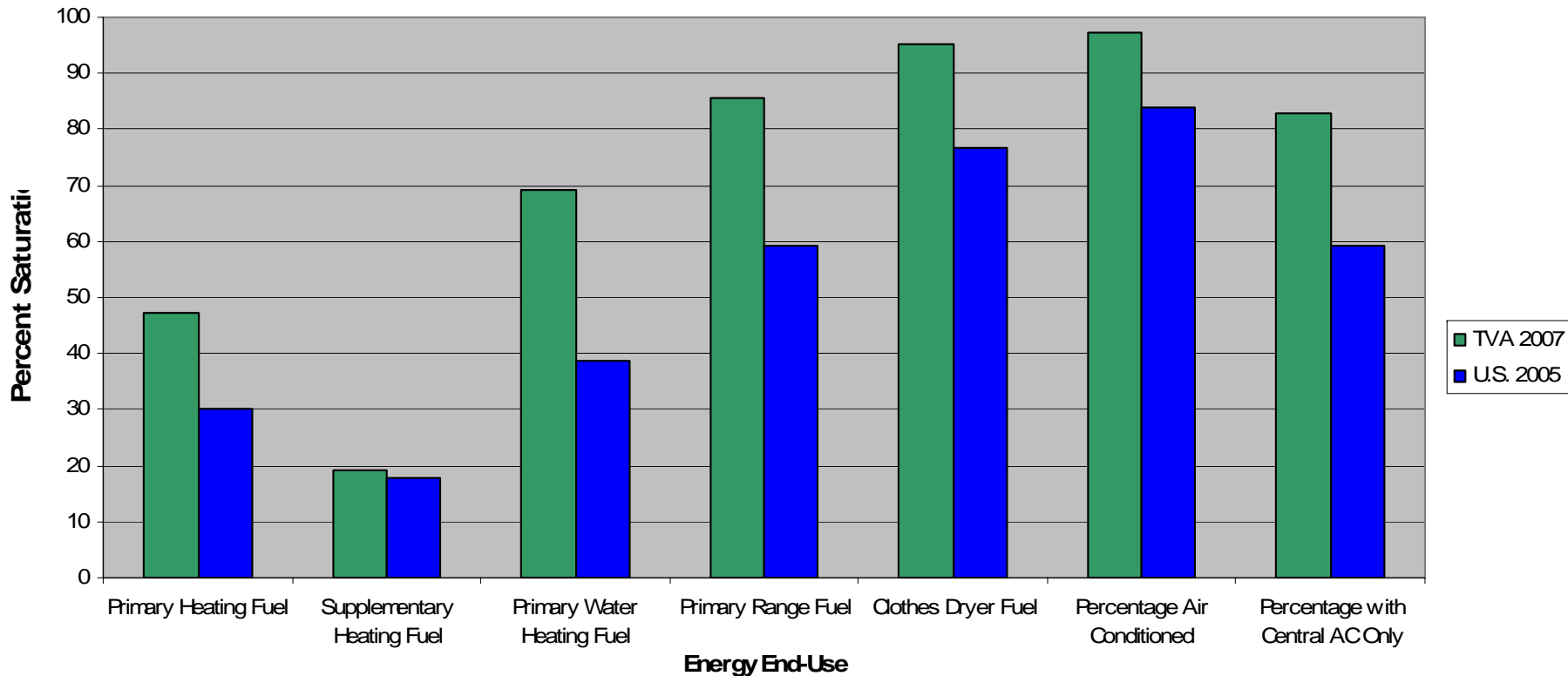


Retail Residential Price of Electricity in TN



Comparison of Electric Saturations

TVA Service Territory vs. National Data



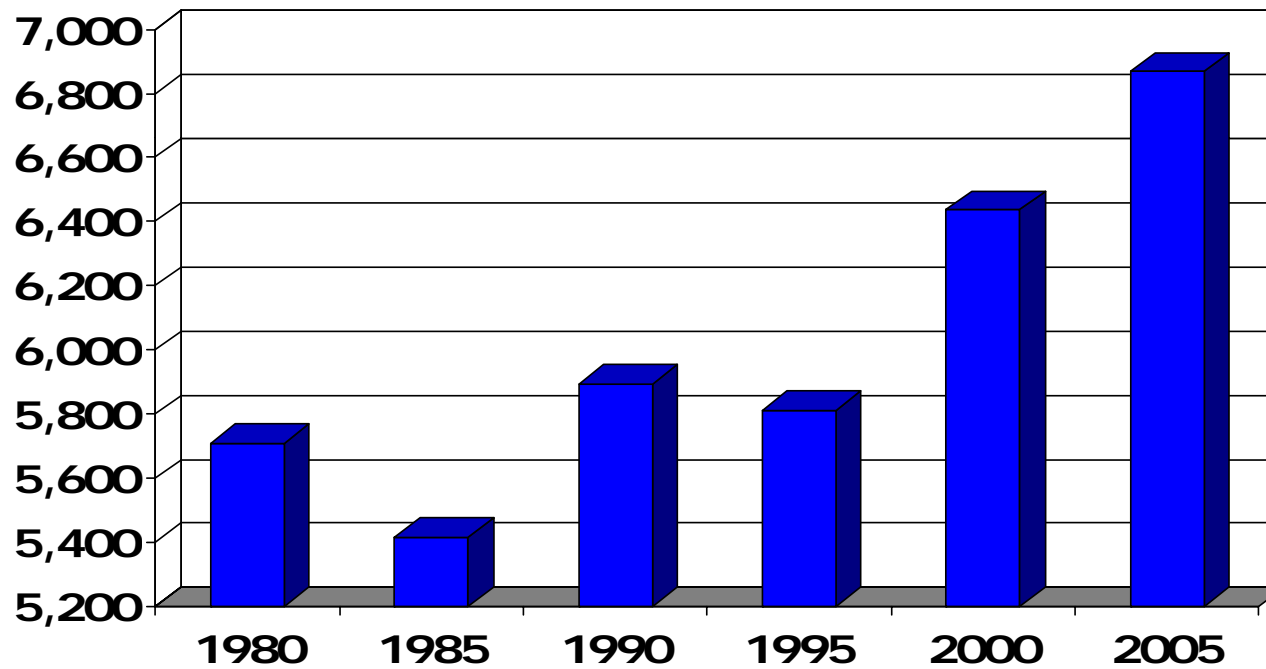
Contributing Factors:

- History of low electricity prices in the Valley
- Lack of universally available alternative fuel due to diminishing natural gas pipeline coverage from West to East in Valley
- Promotion of wise and efficient use of electricity has led to widespread use of heat pumps
- Convenience and lower installation costs of electric heating option, especially in multi-family construction

Sources:

- TVA 2007 Residential Saturation Survey
- DOE EIA 2005 RECS Survey

Tennessee Residential Electricity Consumption Per Capita (kWh)





Trends in TVA Service Territory and Beyond

- Percentage of homes over 2,000 ft.² have been steadily increasing
 - 10% of housing stock in 1979
 - Almost 33% now
- The number of consumer electronics products in the typical home has doubled since 1997. Consumer electronics now account for an estimated 11% of residential electricity use nationally. The growth threatens to negate other household efficiency improvements
- Saturation of heat pumps (a more efficient source of electric heating) has been steadily increasing
 - 20% of electric heat in 1979
 - Over 80% now



EIA National Data

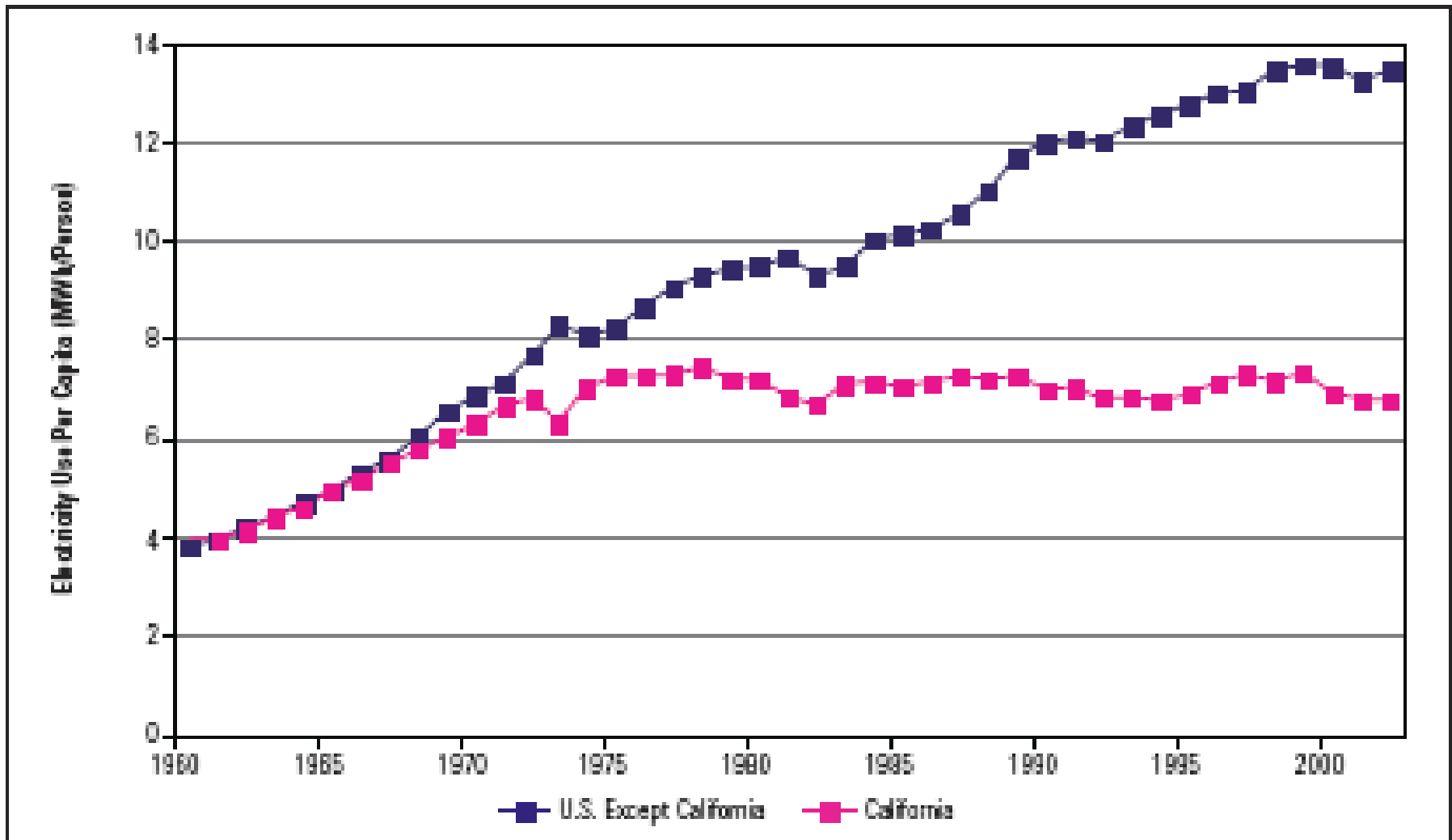
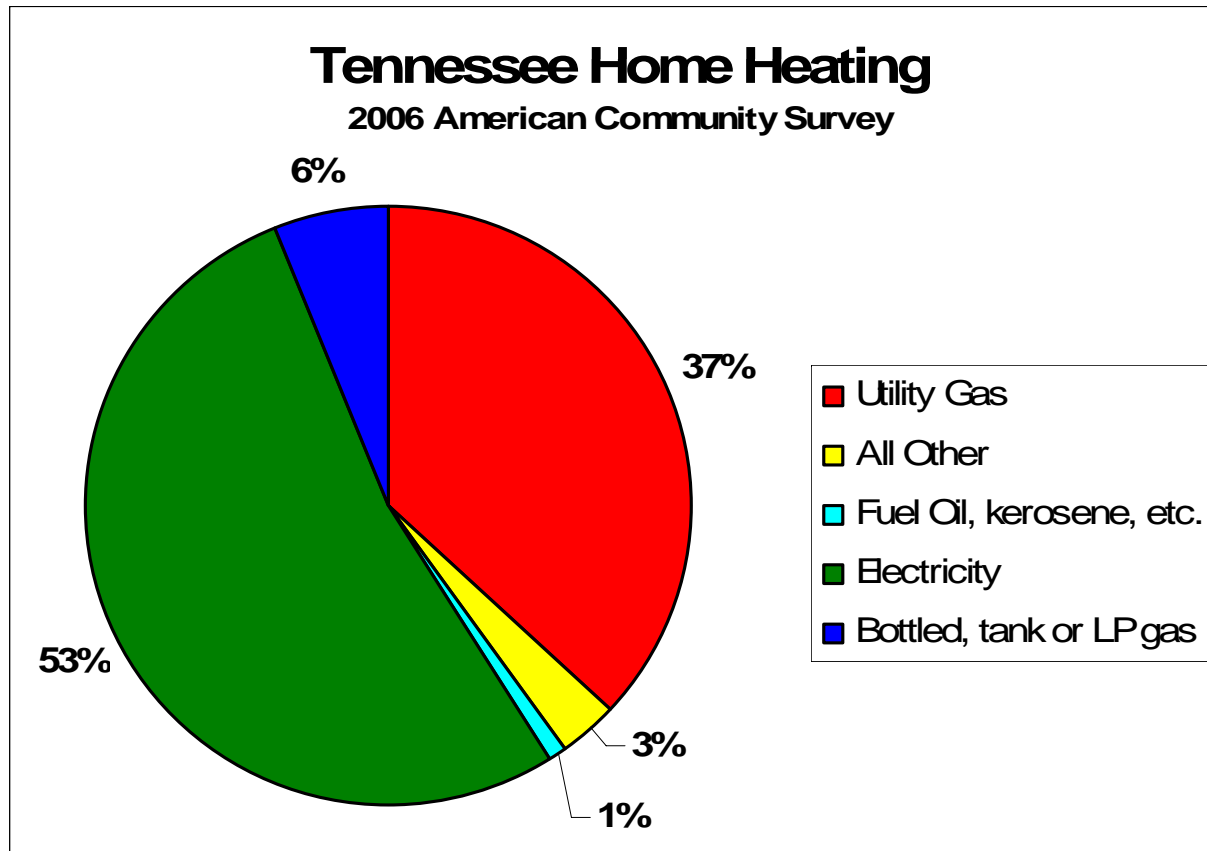


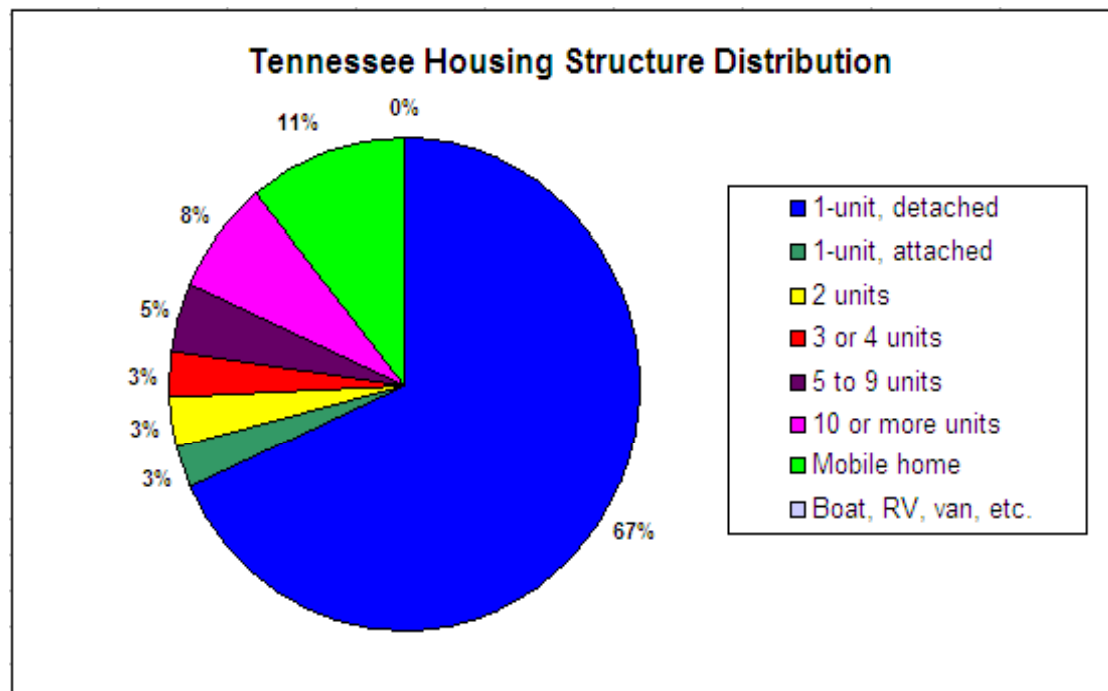
FIGURE 2: Comparison of Electricity Use Per Capita²³

Tennessee Home Heating

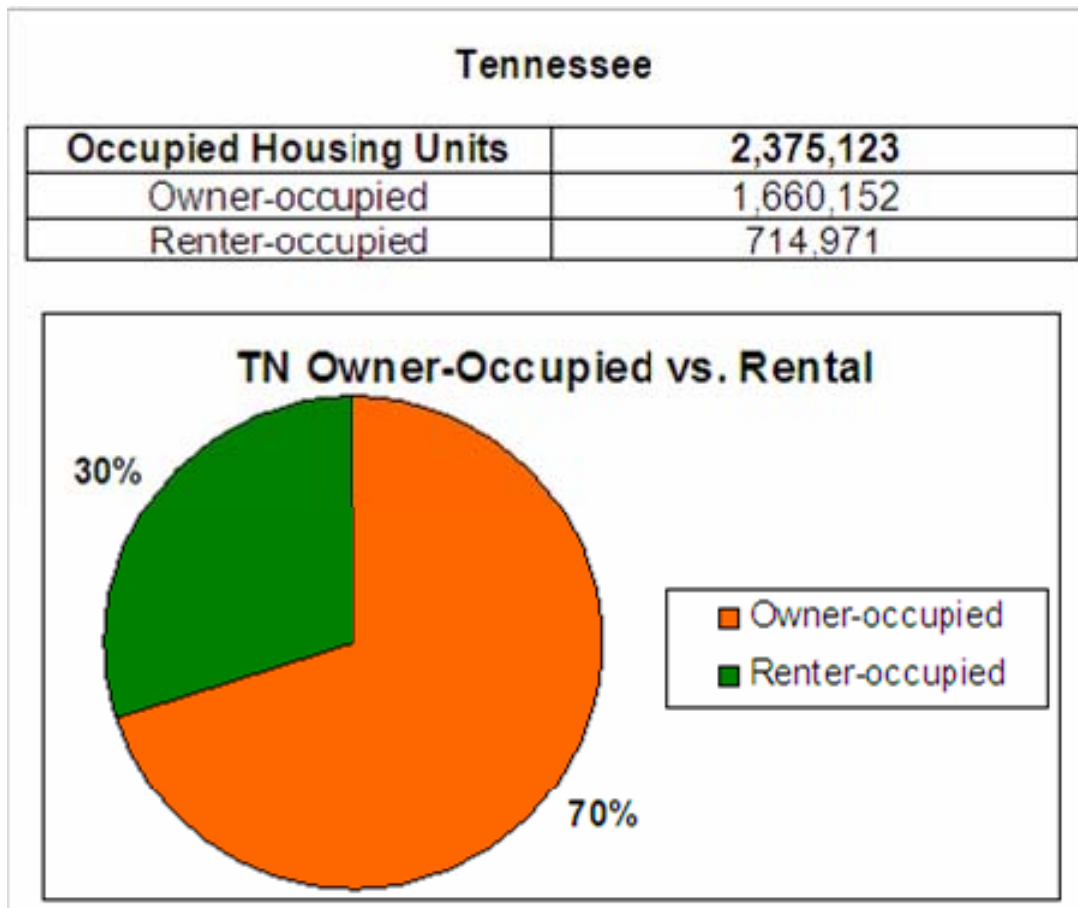


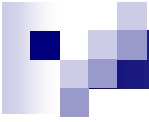
Housing Structure Distribution

- There are over 2.68 million housing units in the state, a majority of which are 1-unit detached structures.
- The housing structure distribution has remained constant since 2000.

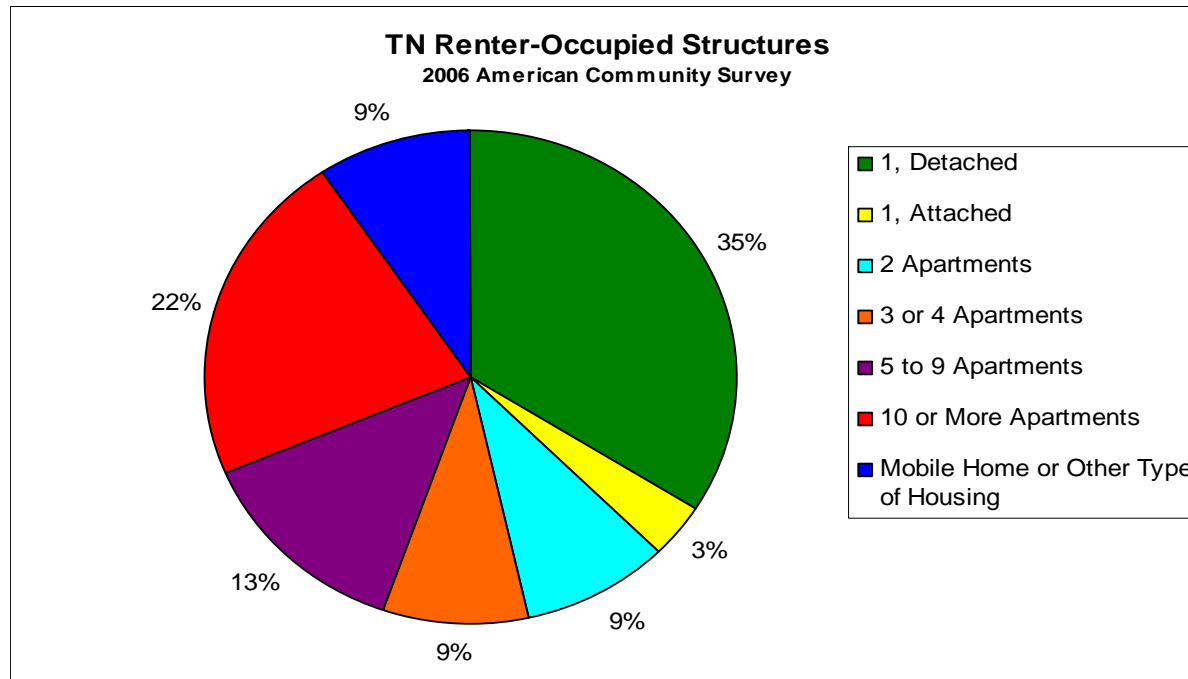


Owner-Occupied vs. Rental Housing





Tennessee Renter-Occupied Housing Units



Tennessee Energy and Poverty

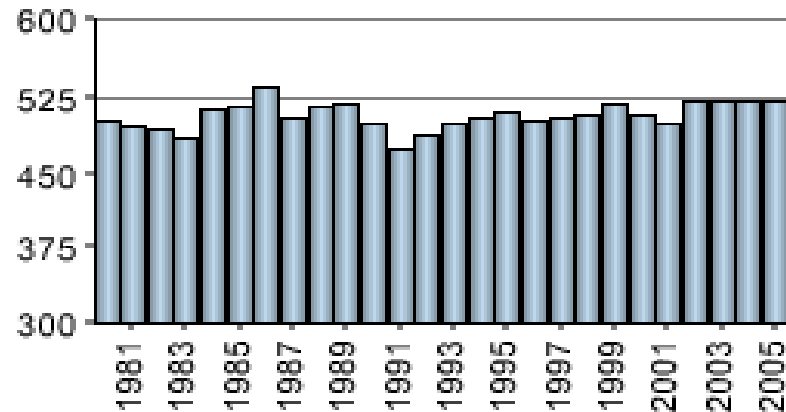
- In 2006, 16.2% of Tennesseans were living below the poverty level.
- Low-income families typically spend 14% of their total annual income on energy costs, compared with 3.5% for other households.
- Memphis very low-income households:
 - Owner households – 26,968
 - Renter households – 47,194
- Nashville-Davidson very low-income households:
 - Owner households – 17,175
 - Renter households – 39,020



Motor Gasoline Consumption in Tennessee

- Total motor gasoline consumption
(Source: EIA Table 7. Energy Consumption Estimates by Source, Selected Years, 1960-2005, Tennessee)
 - 54,948 thousand barrels in 1980
 - 74,371 thousand barrels in 2005
 - 35% increase in consumption
- In 2005, Tennessee used 522 gallons of gasoline per capita, which is higher than the U.S. average of 475 gallons per capita.

Motor Gasoline Consumption per Capita 1980 - 2005
(gallons)

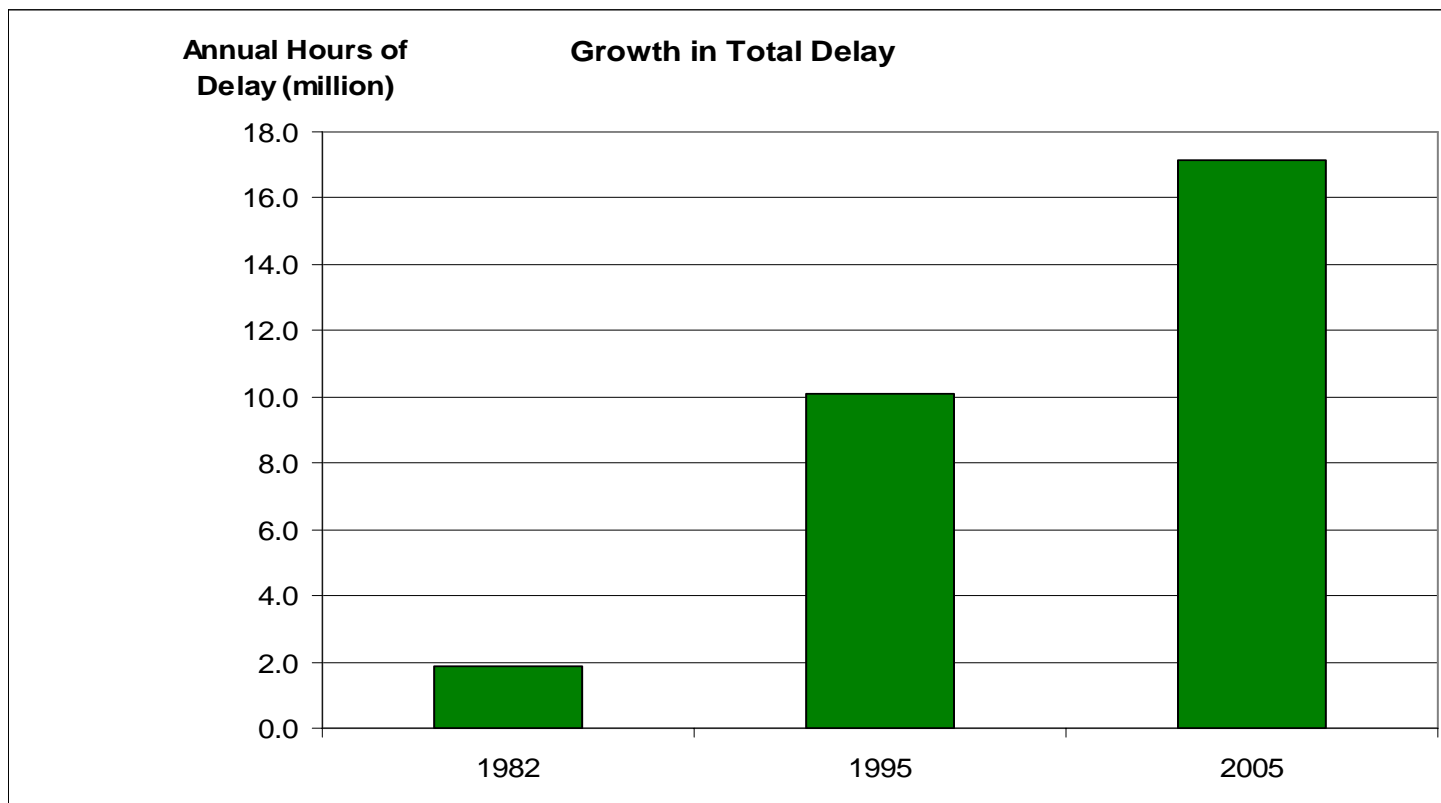


2005 Top-Ten States for Most VMT per capita

Source: US DOT/RITA/BTS, Table 5-3: Highway Vehicle Miles Traveled (VMT)

Rank	State	Total VMT (millions)	Estimated Population	VMT per capita
1	Wyoming	9,058	509,294	17,785
2	Mississippi	42,186	2,921,088	14,442
3	Oklahoma	47,019	3,547,884	13,253
4	Alabama	59,661	4,557,808	13,090
5	Georgia	113,509	9,072,576	12,511
6	New Mexico	23,966	1,928,384	12,428
7	Vermont	7,713	623,050	12,379
8	Montana	11,126	935,670	11,891
9	North Dakota	7,570	636,677	11,890
10	Tennessee	70,814	5,962,959	11,876
	United States	2,989,807	296,410,404	10,087

Memphis TN-MS-AR Congestion Trends





Barriers

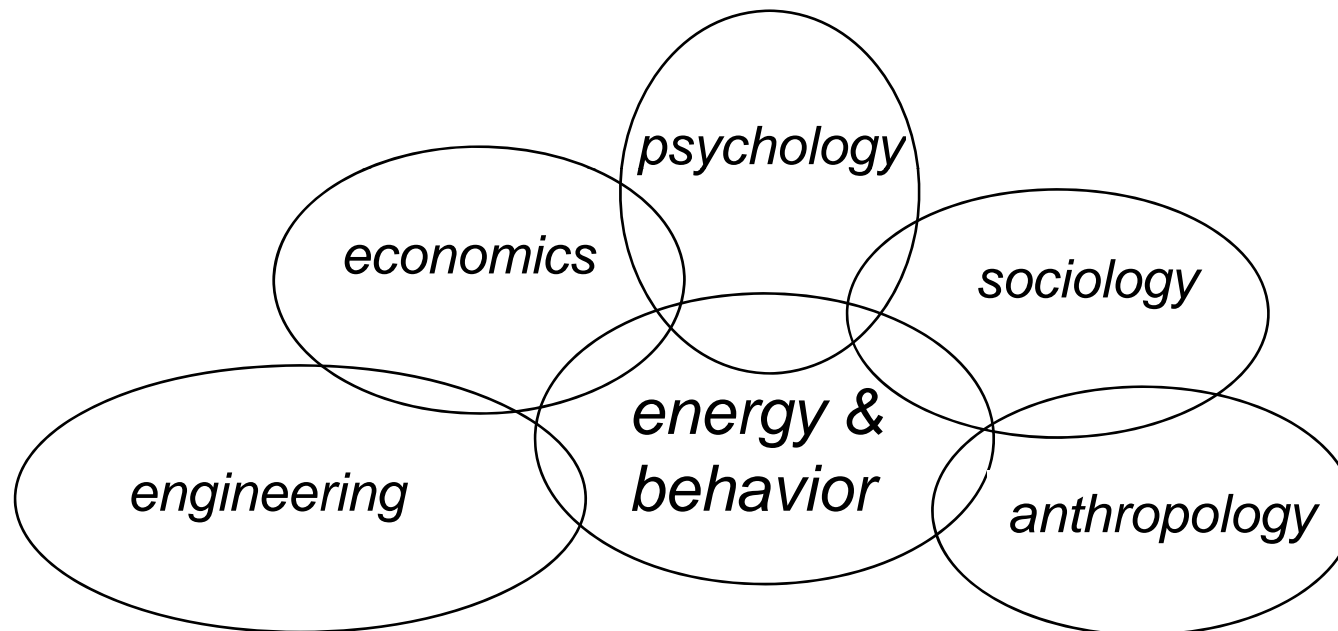


Barriers: Overview

- Information (Policymakers, Experts, and Individuals)
- Control (Landlord/Tenant; Builder/Buyer)
- Timing of Costs and Benefits
- Financial Constraints
- Discount Rates
- Convenience
- Habits
- Intermediaries (HVAC sellers)
- Social Pressures
- Varied Population
- Law

Behavioral Research: Disciplines Involved

(Lutzenhiser, 2008)





Interests and Perspectives

(Lutzenhiser, 2008)

Sociology	households, organizations, communities, institutions, status, technological change *
Anthropology	cultures, folk models, meanings, practices, habitation *
Psychology	attitudes, motivation, information, perception, behavior change *
Economics	prices, costs, financial incentives, benefits **
Engineering	technologies (hardware & controls), systems **

* Shared interest in norms & group process

** Shared interests in costs/benefits



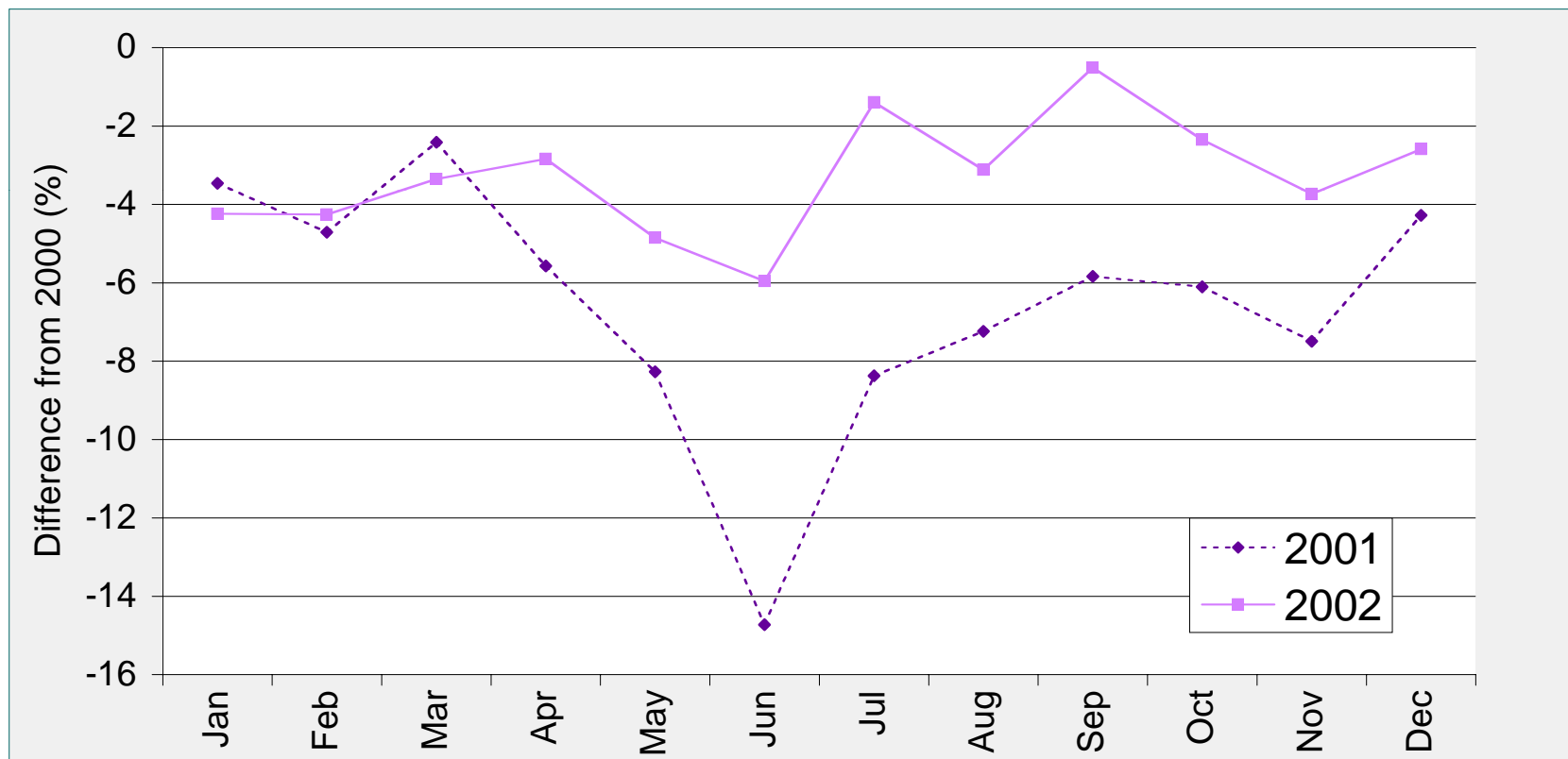
Influences Beyond Price and Technology

- Participation differed by a factor of more than 10:1 among the programs for seven utilities implementing a common BPA-designed program in the early 1980's
- Different behaviors in identical buildings can result in >300% differences in energy use (Lutzenhiser 1992)
- Surprisingly large amounts of efficiency and conservation activities occurred during the California energy crisis in 2001-2002 (Lutzenhiser 2008)

California Energy Crisis

Declines in Consumption over Two Years

(Lutzenhiser, 2008)





Characteristics of Successful Programs

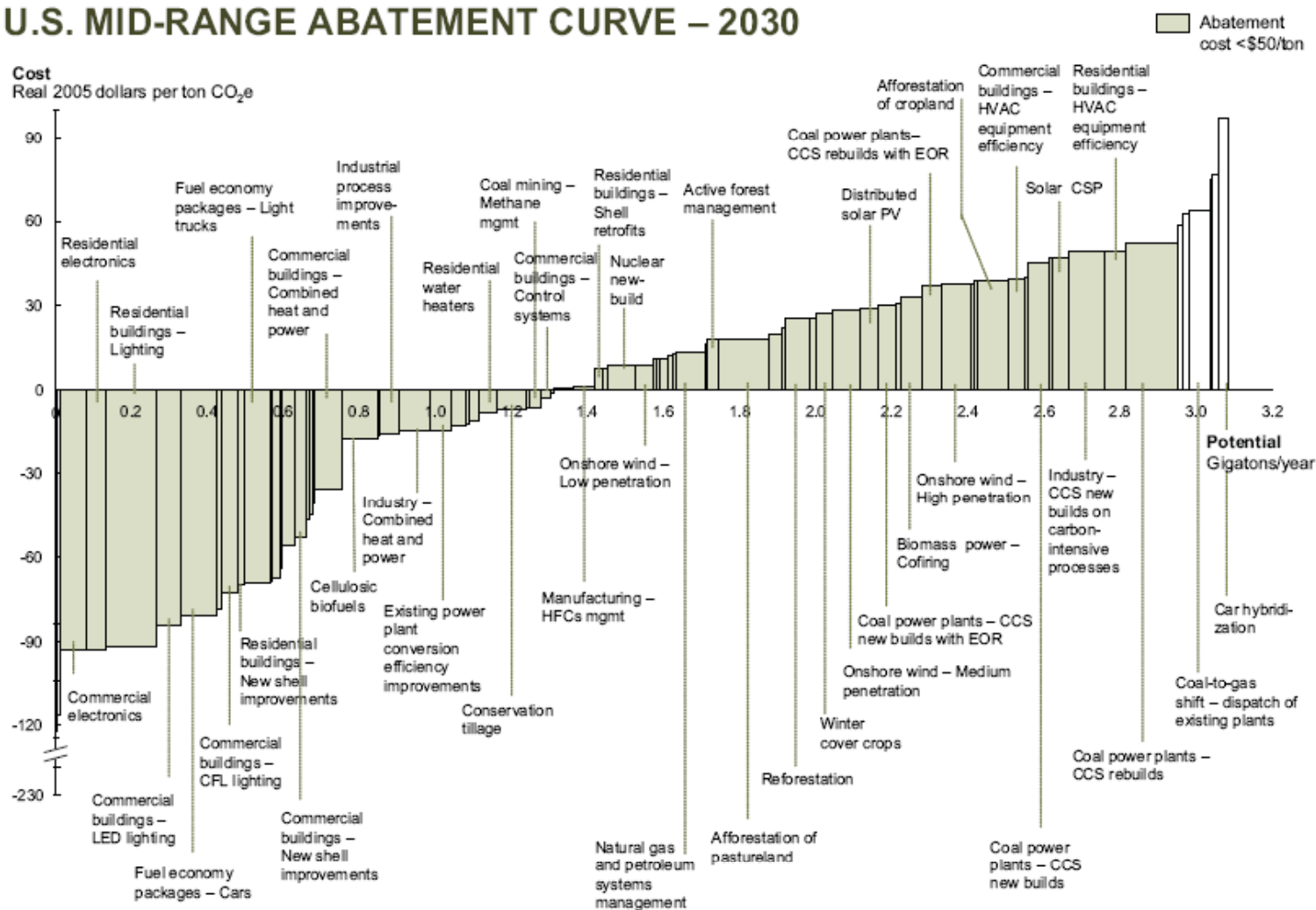
- Address Barriers
- Mix of Interventions
- Information for Public Awareness
- Specific Information/Feedback
- Mix of Financial Incentive Types
- Convenience Enhancements
- Credibility Enhancements
- Informal Social Networks
- Social Pressures
- Varied Population
- Program Evaluation and Modification



Opportunities and Policy/Program Options

Opportunities

U.S. MID-RANGE ABATEMENT CURVE – 2030



Source: McKinsey analysis

Source: McKinsey (2007)



Policy and Program Buckets

- Information and Education
- Pricing and Incentives
- Regulation



Bloomberg & Gates Announce \$500 Million Anti-Smoking Campaign – July 2008

- Elements/goals of the comprehensive campaign include:
 - Information and Education:
 - Anti-smoking advertising campaign
 - Pricing & Incentives:
 - Raise tobacco taxes
 - Offer citizens nicotine patches and other assistance to quit smoking
 - Regulation:
 - Outlaw smoking in public places
 - Outlaw advertising to children
 - Outlaw free tobacco giveaways



Residential Energy: Information & Education

- Public education campaign on energy use and costs and guide to specific residential actions
- Information for homeowners and renters on available programs and products
- Household energy audits
- Usage feedback in homes and vehicles
- Training for architects, builders and local code officials
- Labeling: Home energy rating systems (HERS), Energy Star appliances, LEED, EPA auto mpg



Residential Energy: Pricing & Incentives

- Utility incentive programs for (beyond-code) energy efficiency and renewable energy (e.g., New England utilities spend over \$250 million/year on energy efficiency—over \$17.50 per capita)
- Utility rate structures: dynamic pricing, inclining block rates
- Other incentive programs for buildings: tax credits, low-interest loans, energy efficient mortgages
- Feebates for more efficient new vehicle purchases
- Incentives to reduce vehicle miles traveled (VMT): telecommuting, 4-day work week, gas taxes, parking fees, roadway pricing, VMT-based insurance



Residential Energy: Regulation

- **Building energy codes**
 - 28 states currently use the 2006 IECC code; TN will move to the 2003 IECC code on 1/1/09
- **Appliance and equipment standards**
 - 10 states currently have appliance efficiency standards
- **Utility regulation**
 - Least-cost procurement
 - System benefit charges (23 states plus DC for energy efficiency/renewables)
 - Renewable portfolio standards (24 states with mandatory standards)
 - Decoupling utility profits from sales (e.g. CA and MA)
 - Distributed generation interconnection standards, and net metering

Note: TVA is federal agency and above “utility regulation options” likely need to be adapted for municipal utility paradigm
- **Smart growth policies**
- **GHG standards for new vehicles**
 - CA plus 17 other states adopted standards

2006 Summary ACEEE Energy Efficiency Scorecard for Tennessee

Category	Max Possible Score	TN Score	Rank*	Methodology
Spending on Utility and Public Benefits Energy Efficiency Programs	15	1	25/51	Spending equal to >\$1.50 per capita
Energy Efficiency Resource Standards	5	0	N/A	No existing programs or upcoming plans for EERS
Combined Heat and Power	5	1	40/51	Adopted at least one policy
Building Energy Codes	5	1	46/51	Only residential code, no commercial; precedes 1998 IECC (does not meet EPCA)**
Transportation Policies	5	1	25/31***	Only land use policy, no tailpipe emissions standard, no transit funding, no fleet efficiency
Appliance and Equipment Efficiency Standards	3	0	N/A	No standards
Tax Incentives	3	0	N/A	No tax incentives
State Lead by Example and R&D	3	0	N/A	No programs: EE Performance Criteria, New/existing state building targets, EE product procurement, R&D
Total Score	44	4		
Overall Rank			43/51	

Source: The State Energy Efficiency Scorecard for 2006, ACEEE Report No. E075 (June 2007)

* A rank of N/A indicates that TN was tied with all other states that also scored zero in a given category

**TN will require compliance with 2003 IECC on 1/1/09

*** 20 states tied for last with zero points

EEDR Objectives:

Illustrative

Near-Term Versus Long-Term Strategies

Near-term, incentives drive efficiency. Over time, market forces drive improvements. Active communication with consumers is a key enabler at every phase.

