Modeling Tools and Frameworks to Support Block 4 Energy Efficiency: NEMS and GT-DSM

Technical Summit on EPA's Carbon Pollution Standards

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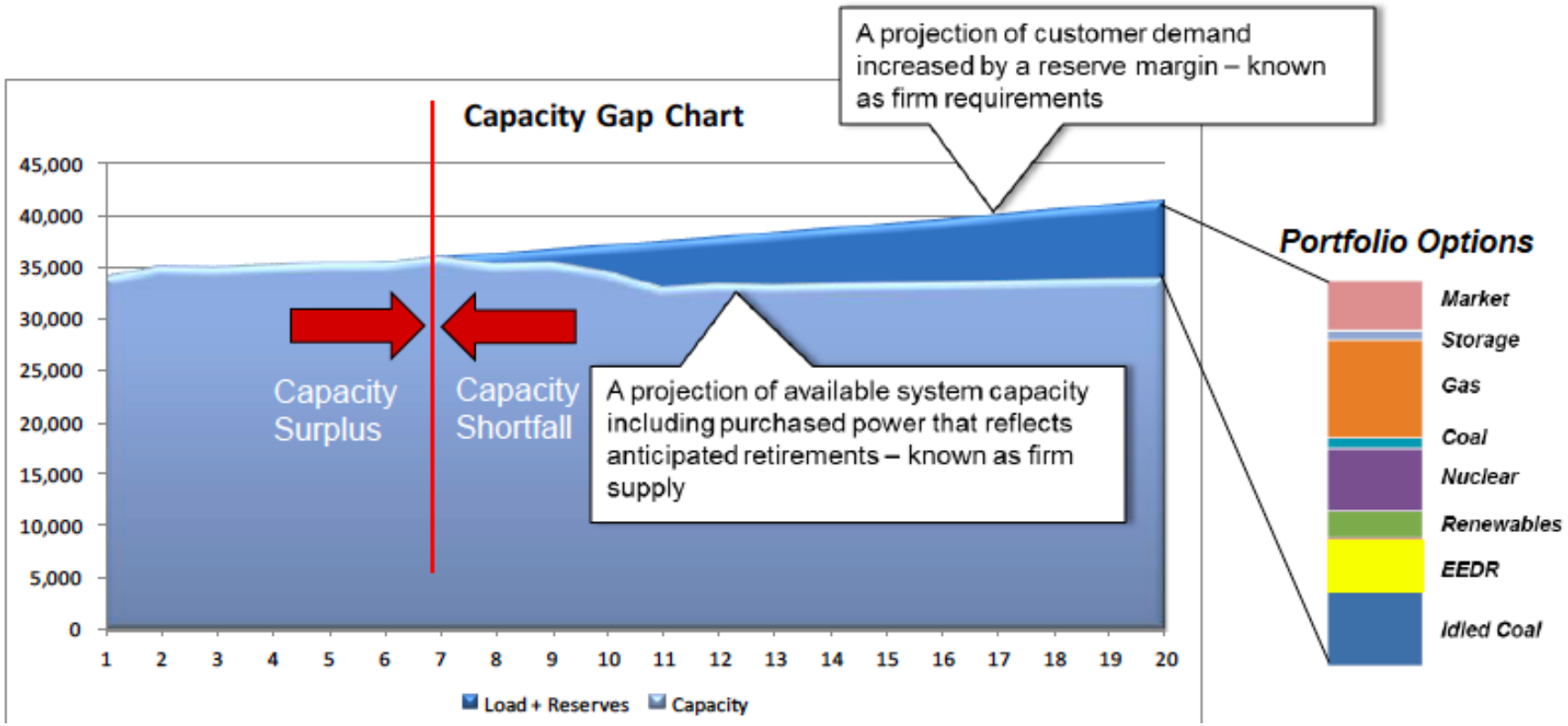
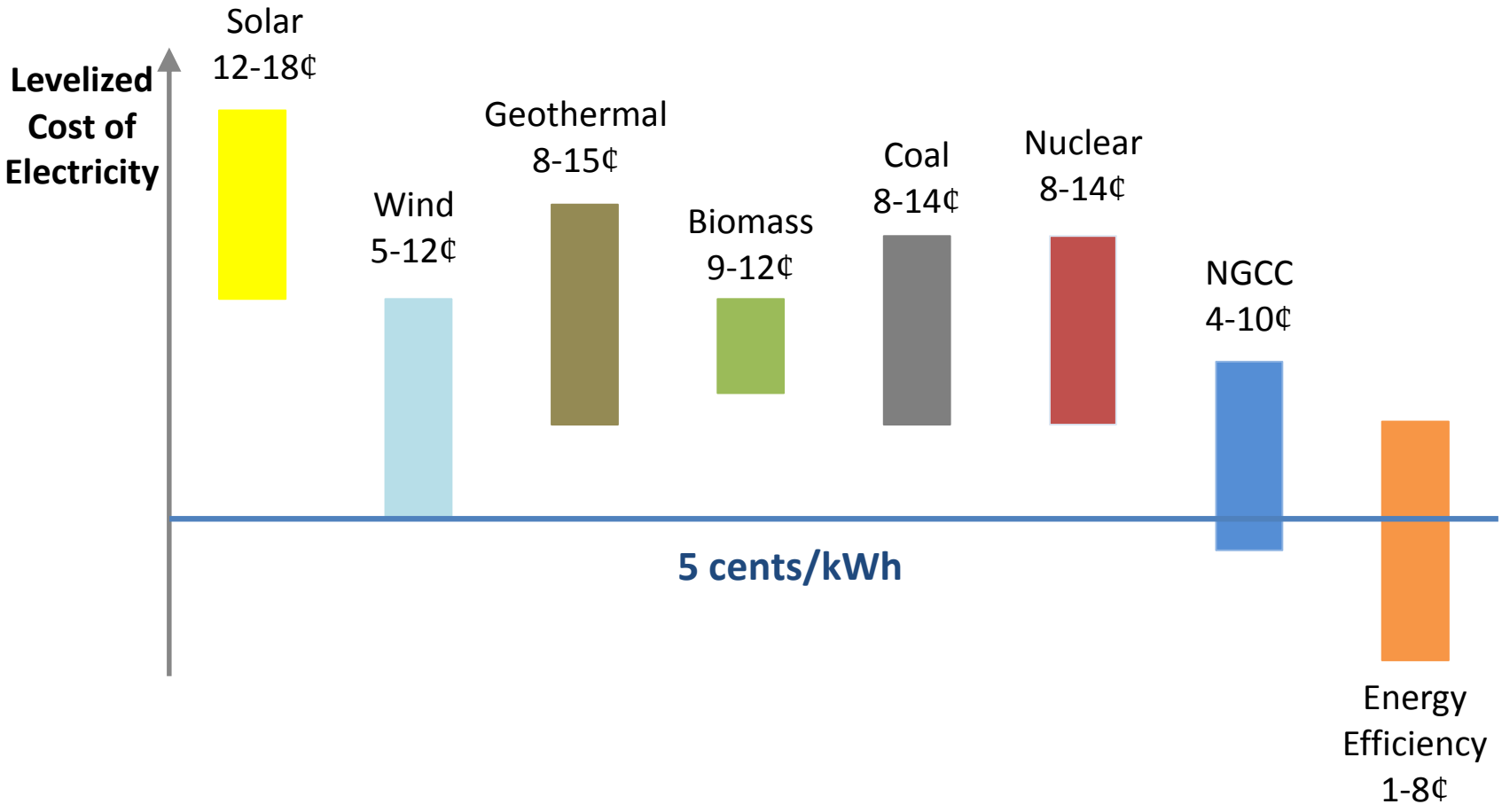
Resource Planning is about Optimizing the Capacity Mix



Joe Hoagland (TVA), May 24, 2014.

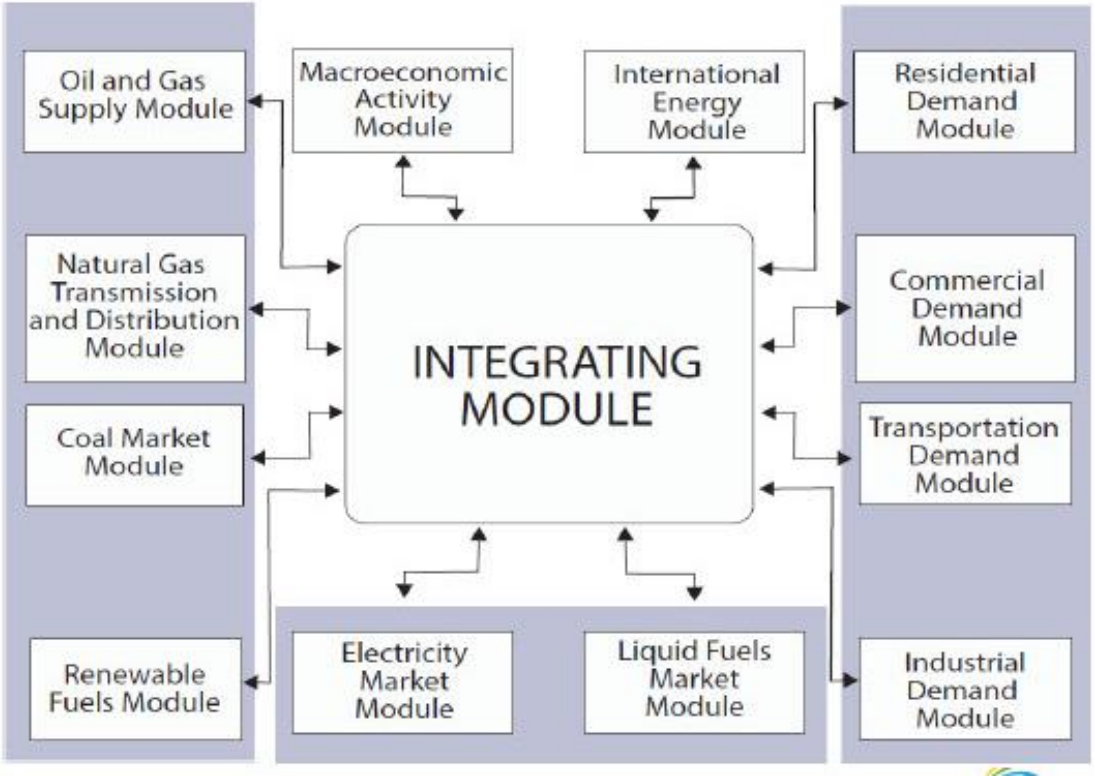
Energy Efficiency: the Least Cost Solution to Climate Mitigation



Data source: Sustainable Energy in America 2014 Factbook, Bloomberg New Energy Finance

National Energy Modeling System (NEMS)

- An energy engineering-economics model with a great deal of technology specificity for characterizing the EE opportunity
- Includes a general equilibrium model with macroeconomic data



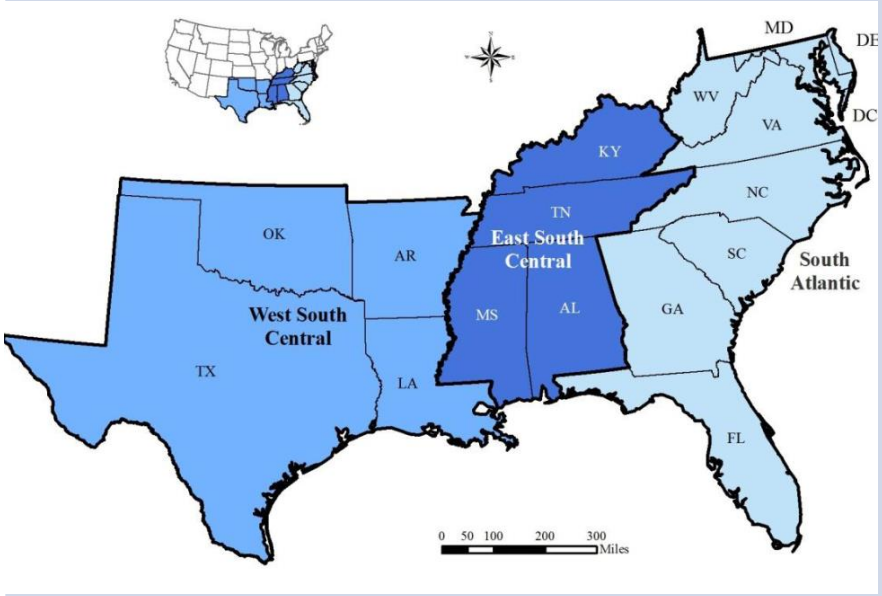
Source: US Energy Information Administration, Office of Energy Analysis, 2013

The South Census Region

West South Central

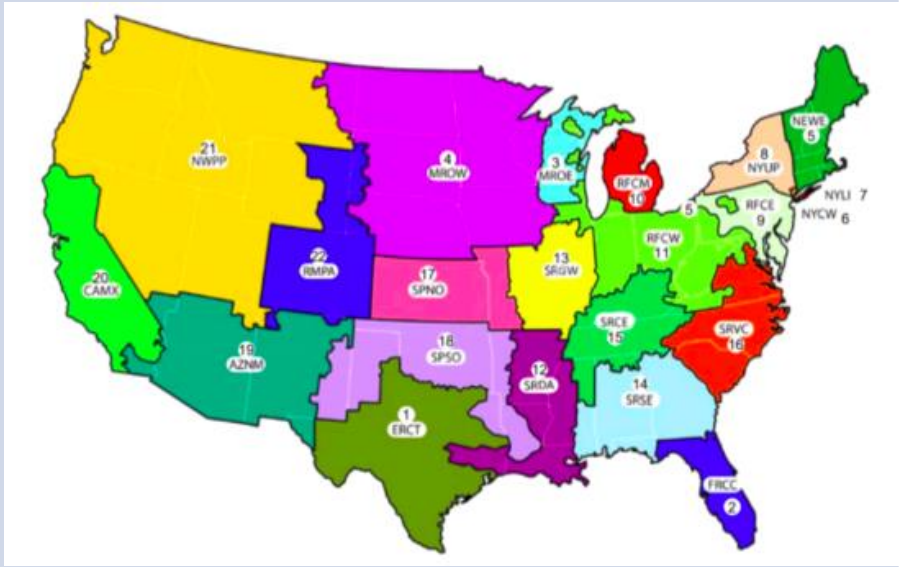
East South Central

South Atlantic



The NERC Reliability Regions

1. ERCOT (TX)
2. FRCC (FL)
12. SERC – Delta (MS, LA, AR)
14. SERC – Southeastern (GA, AL, MS)
15. SERC – Central (KY, TN, LA, AL)
16. SERC – Virginia and Carolinas
18. SPP-South (OK, AR, LA, TX, NM)



GT-NEMS used to Evaluate 11 EE Policy Measures

Sector	Policy Type	Policy	Scenario Description
Residential	Financial	Appliance Incentives	Providing 30% subsidy
	Financial	On-Bill Financing	Offering zero-interest loans
	Regulatory	Building Codes	Adding four new building codes
	Regulatory	Aggressive Appliance Policy	Phasing out the least efficient ones from the market
	Information	Market Priming	Lowering discount rates (10-50%) to 7% for private investment
Commercial	Financial	Financing	Offering flexible financing options
	Regulatory	Building Codes	Requiring higher building shell efficiency
	Information	Benchmarking	Sharing building energy consumption data to
Industrial	Regulatory	Motor Standard	Requiring efficiency improvement and 25% more savings for motor systems
	Financial	CHP Incentives	Offering a 30% investment tax credit (ITC)
	Information	Plant and Technology Upgrade	Increasing productivity by plant utility upgrades

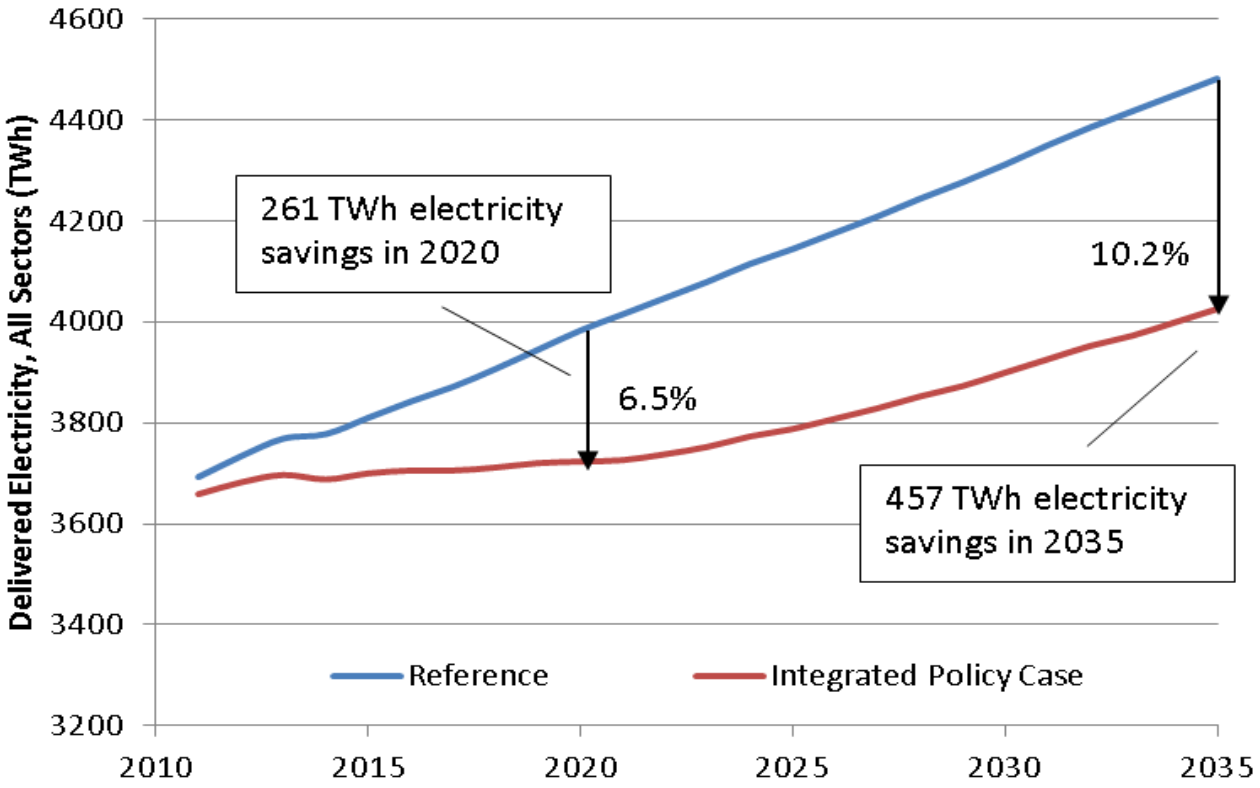
Two-tiered Modeling Approach

- 11 energy efficiency policies were modeled individually in 11 stand- alone policy scenarios
  - to evaluate individual policy impact
  - to estimate levelized cost
- All policies were then modeled in combination in an Integrated Policy Scenario
- Policy impacts were analyzed against the Annual Energy Outlook 2011 reference case

Wang, Yu and Marilyn A. Brown. 2014. “Policy Drivers for Improving Electricity End-Use Efficiency in the U.S.: An Economic-Engineering Analysis”. *Energy Efficiency,* 7(3): 517-546.

Significant Energy Benefits

- About 10% of electricity savings in 2035—above the "implicit" EE improvement – characterized as an incomplete estimate.
- Additional 70 TWh CHP generation being sold back to the grid

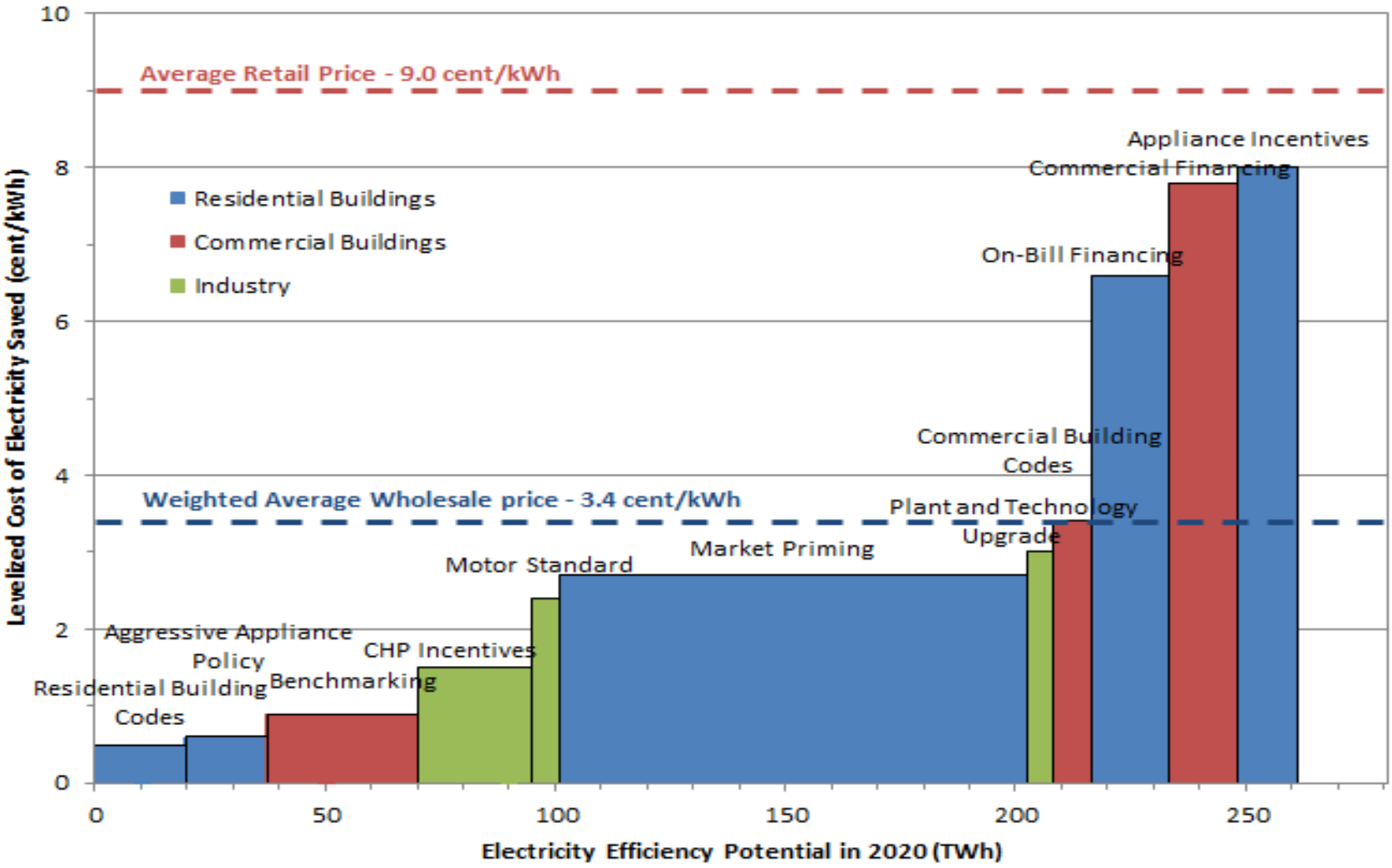


Levelized Cost Estimates by Policy

- LCOE ranging from 0.5 – 8.1 cent/kWh

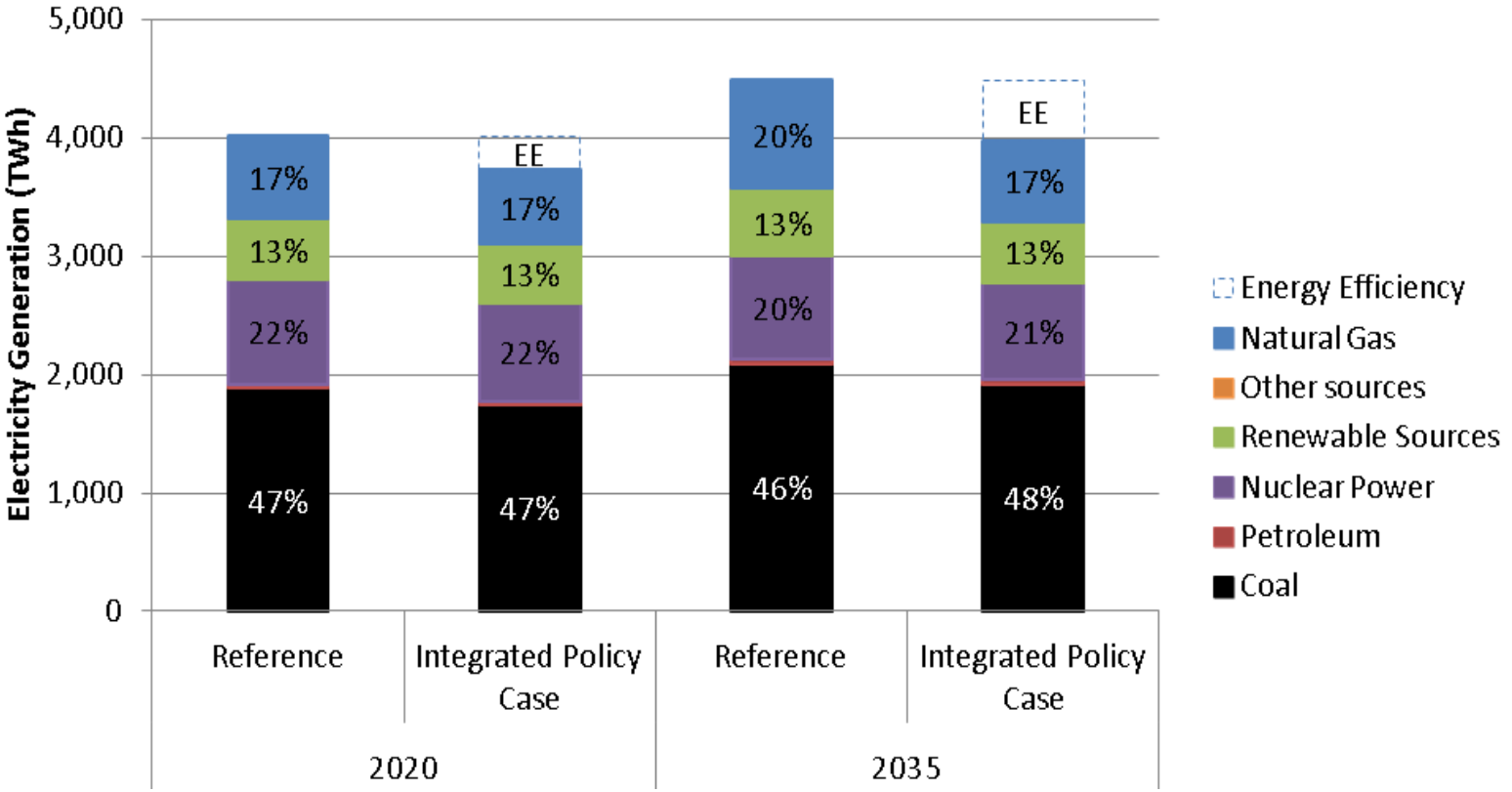
Sector	Policy	Electricity Savings (TWh)		LCOE
		2020	2035	(cent/kWh)
Residential	Appliance Incentives	17.6	35.5	6.7-8.0
	On-Bill Financing	20.2	33.4	6.6-7.4
	Building Codes	27.0	51.0	0.5-0.8
	Aggressive Appliance Policy	23.4	59.2	0.6-0.7
	Market Priming	136.9	164.1	2.7-3.6
Commercial	Financing	22.6	82.6	7.8-8.1
	Building Codes	11.1	46.3	3.4-4.6
	Benchmarking	44.3	107.0	0.9-1.4
Industrial	Motor Standard	8.4	12.3	2.4-3.9
	Plant and Technology Upgrade	7.6	21.7	3.0-4.8
	CHP Incentives	33.4	39.3	1.5-2.3

Policy Supply Curve for Energy Efficiency

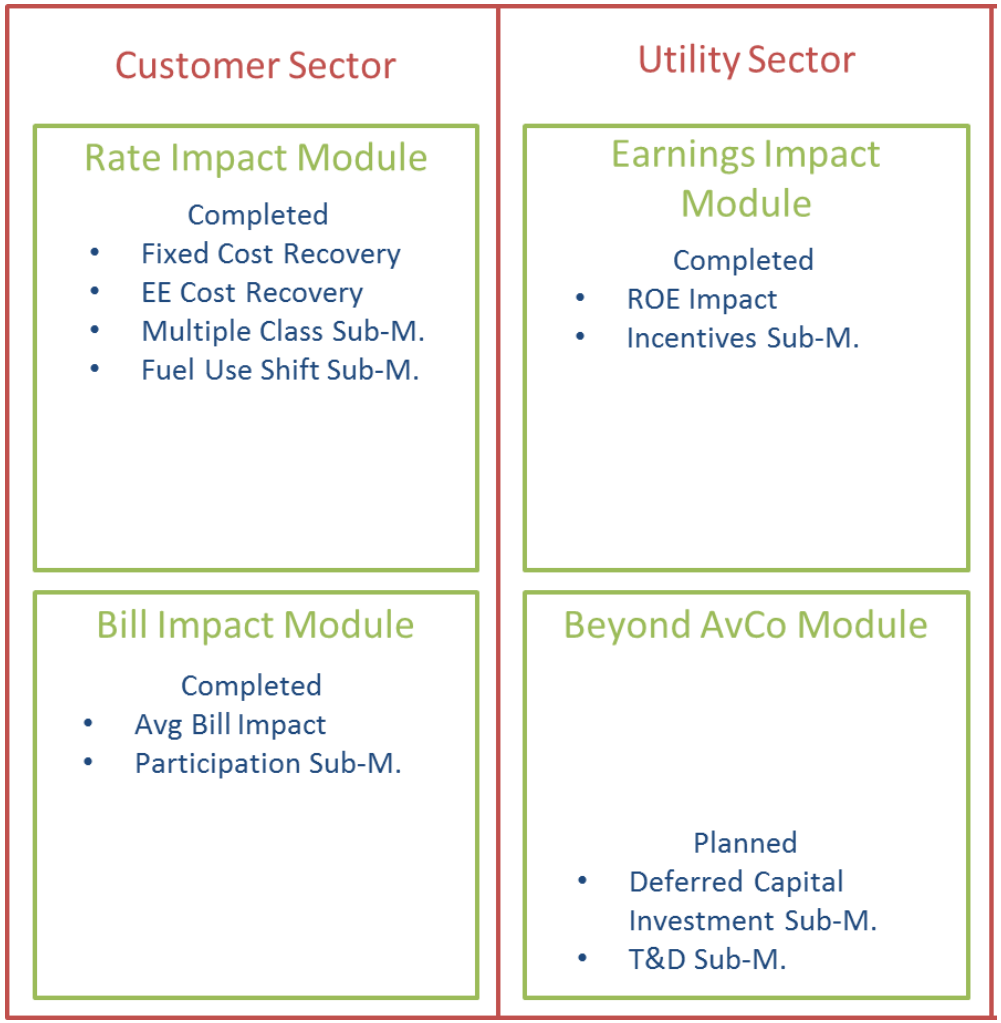


Policy Impact on the Power Sector

- Fewer power plants will be built
- More than 200 TWh (25%) of generation from natural gas will be offset by efficiency improvement



Georgia Tech-Demand Side Management (GT-DSM): Public Domain Spreadsheet Model



- GT-DSM is designed to evaluate utility-funded EE programs
  - Estimates bills, rates, utility earnings & ROE impacts from EE
  - Relies upon publicly-available data to characterize utility economics and EE program parameters
  - Free to license and open-source

GT_DSM available online at
http://cepl.gatech.edu/drupal/sites/default/files/GT-DSM_Beta.xlsx

GT-DSM computes alternative business models for utility-funded EE

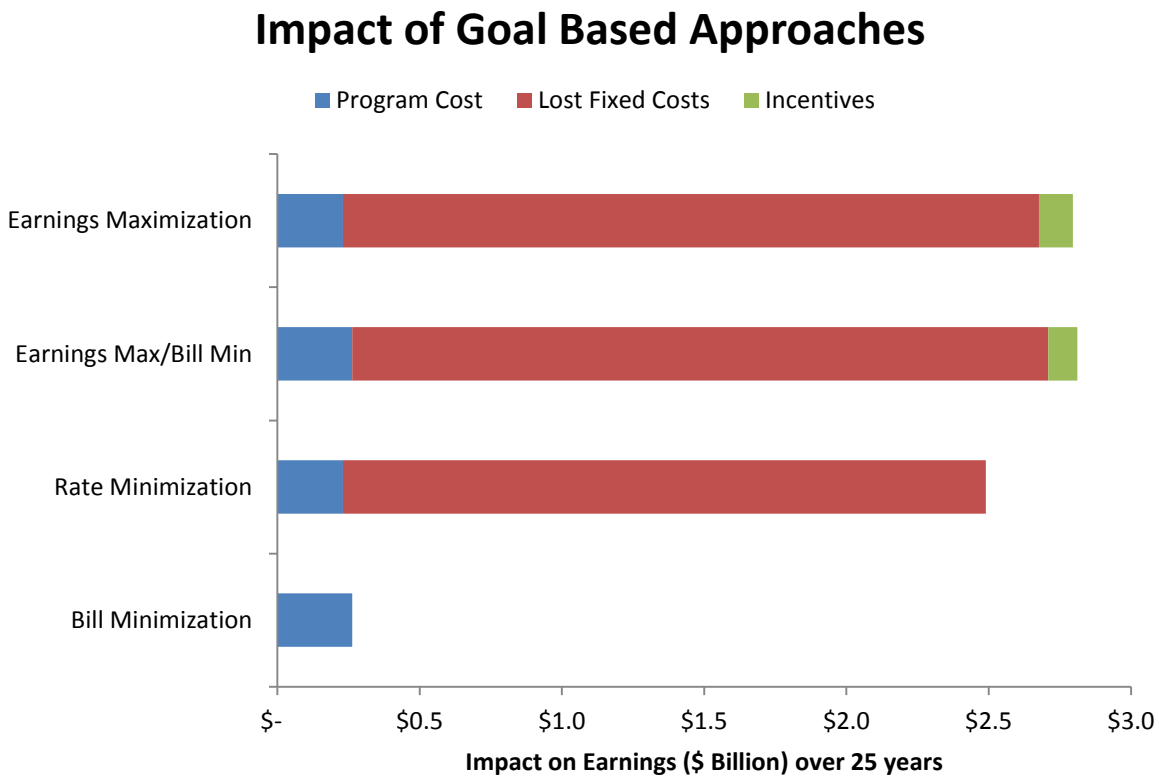
- Capable of representing multiple components of utility EE business models
  - NAPEE's "three-legged stool"
- Components calculate stakeholder impacts from variations in:
  - Recovery of program costs
  - Recovery of lost contribution to fixed cost
  - Provision of performance incentives
- Examining business model impacts to Southeastern utility

GT-DSM: Scenarios

- Different business cases achieve different goals:

	Recovery of Program Costs	Recovery of Lost Contribution to Fixed Cost	Provision of Performance Incentives
Earnings Maximization	Expensed	LRAM	Net Savings
Earnings Max/Bill Min	Amortized	SFVR	Gross Savings
Rate Minimization	Expensed	Per Customer	N/A
Bill Minimization	Amortized	N/A	N/A

GT-DSM: Impact on Utility Earnings



Recovering lost contributions to fixed costs has the biggest impact of the three “legs.”

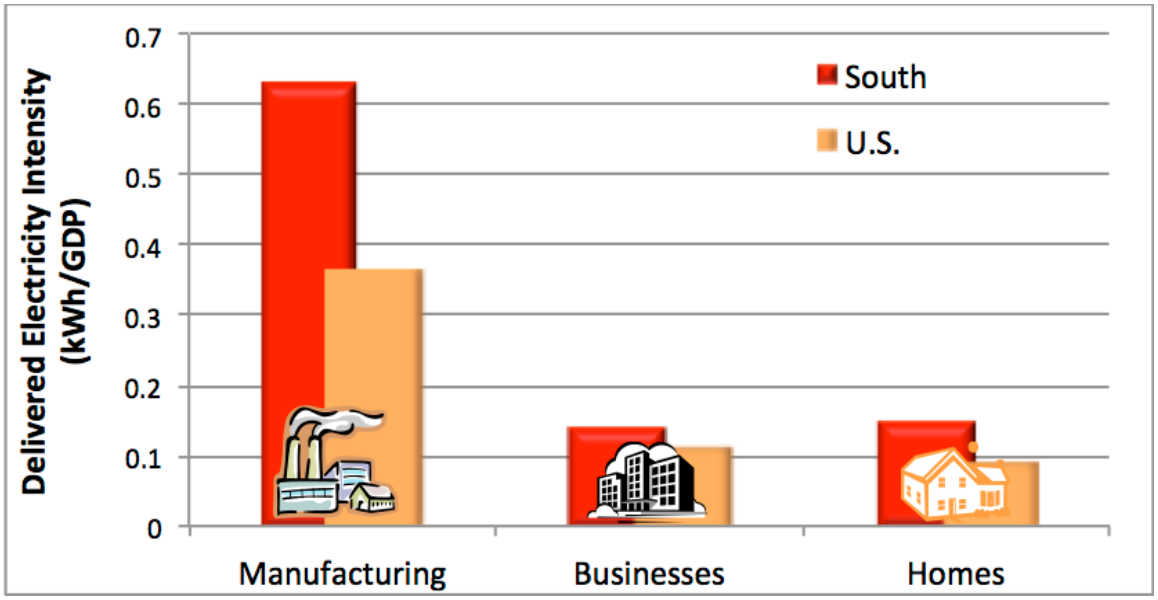
Business Models Can Affect Participants & Non-Participants Differently

- Lost revenue adjustment mechanism (LRAM) distributes impact across participants and non-participants
- Straight fixed variable rate (SFVR) has same average bill impact, but mostly on participants

	Average Bill Impact (%)	Participant Bill Impact (%)	Non-participant Bill Impact (%)
SFVR	-4.0%	-17.8%	-0.3%
LRAM	-4.1%	-22.8%	0.7%

Conclusions

- The energy efficiency potential in the South is large (<1%/year)



- What actions can unleash this potential and how can compliance be enforced? Good models can help.

For More Information

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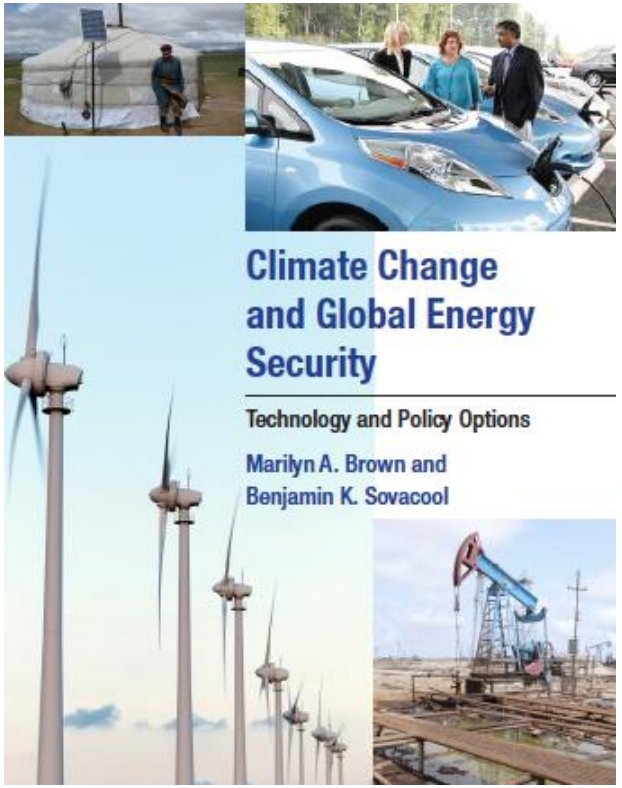

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