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TRANSFORM 2017

SEEA & AESP SE Conference
October 16th - 18th | Atlanta, GA

Valuing EE for Meeting Grid and Customer Needs

Speakers:

Jack Mayernik, U.S. Department of Energy

Natalie Mims, Lawrence Berkeley National Lab

Dave Ball, Georgia Power

Jim Hearndon, Nexant (moderator)

TRANSFORM 2017

Learning Objectives

By participating in this session you will:

- **Gain exposure to a more dynamic conception of energy efficiency**
- **Learn how the time varying value of energy efficiency can have regional implications**
- **Learn how and why utilities benefit from considering the time-value of energy efficiency**
- **Learn why this matters as distributed energy resources play a grater role on the grid**

Time-Varying Value of Energy Efficiency

Southeast Energy Efficiency Alliance and AESP Southeast Conference

Natalie Mims

October 17, 2017

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Project Objective and Scope

- Advance consideration of the value of demand-side energy efficiency measures during times of peak electricity demand and high electricity prices through quantitative examples of the value of energy efficiency at times of system peak
- Increase awareness of available end-use load research and its application to time-varying valuation of energy efficiency
- Increase awareness of the gaps in, and need for, research on energy savings shape
- Recommend methodology(ies) to appropriately value energy efficiency for meeting peak demand
- Consider changes to efficiency valuation methodologies to address the changing shape of net load (total electric demand in the system minus wind and solar)

Study Approach

- Summarize state of end-use load research and existing analyses that quantify benefits of electric efficiency measures and programs during peak demand and high electricity prices
- Document time-varying energy and demand impacts of 5 measures in 4 locations:

Measures

- Exit sign (Flat load shape)
- Commercial lighting
- Residential lighting
- Residential water heater
- Residential air conditioning

State/Region

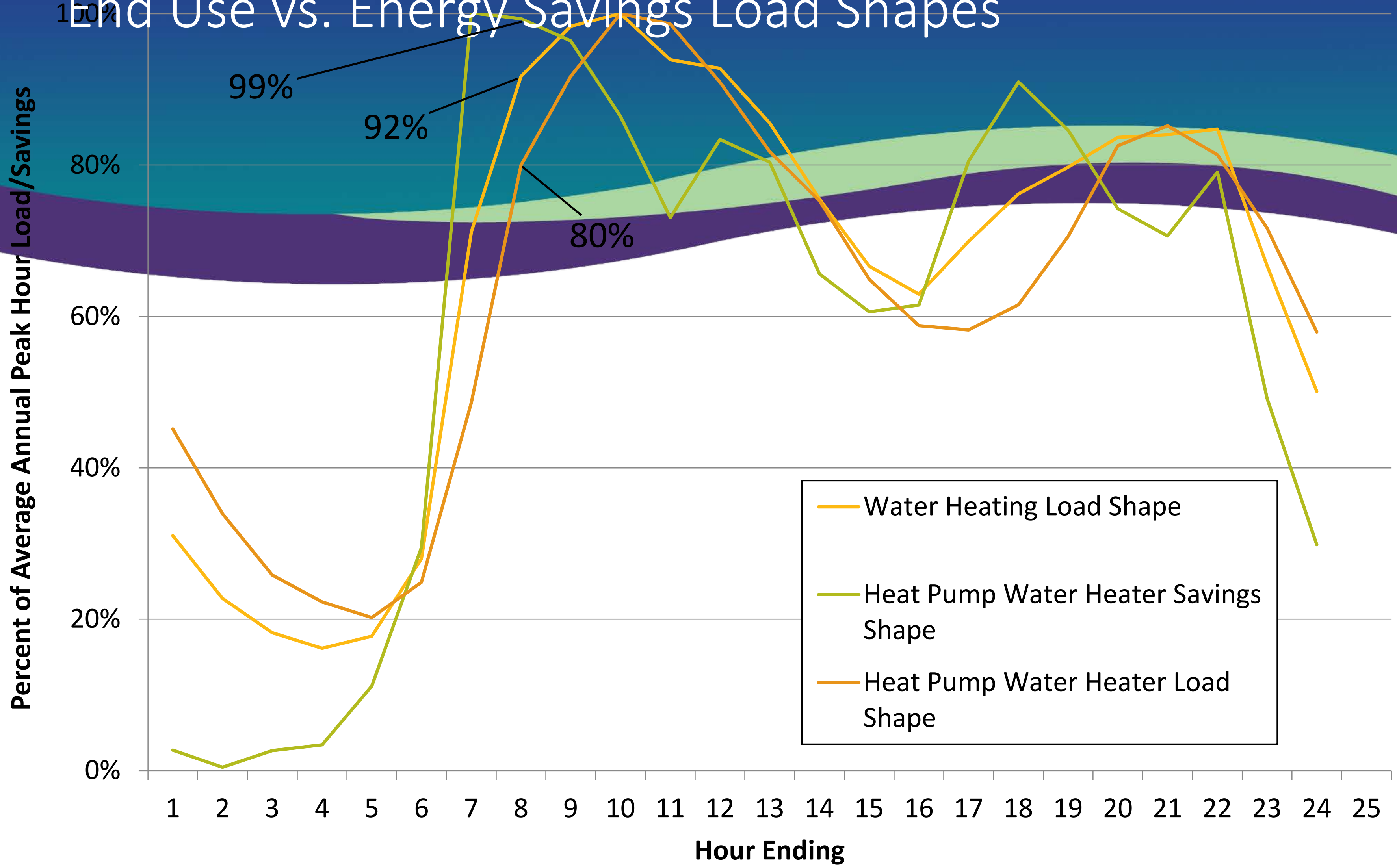
- Pacific Northwest
- California
- Massachusetts
- Georgia

- Use publicly available avoided costs from each location and one of the following methodologies:
  1. Use seasonal system peaks, coincidence factors and diversity factors to determine peak/off-peak savings and apply seasonal avoided costs to savings, *or*
  2. Apply hourly avoided costs to each measure load shape to calculate the time-varying value of measure.

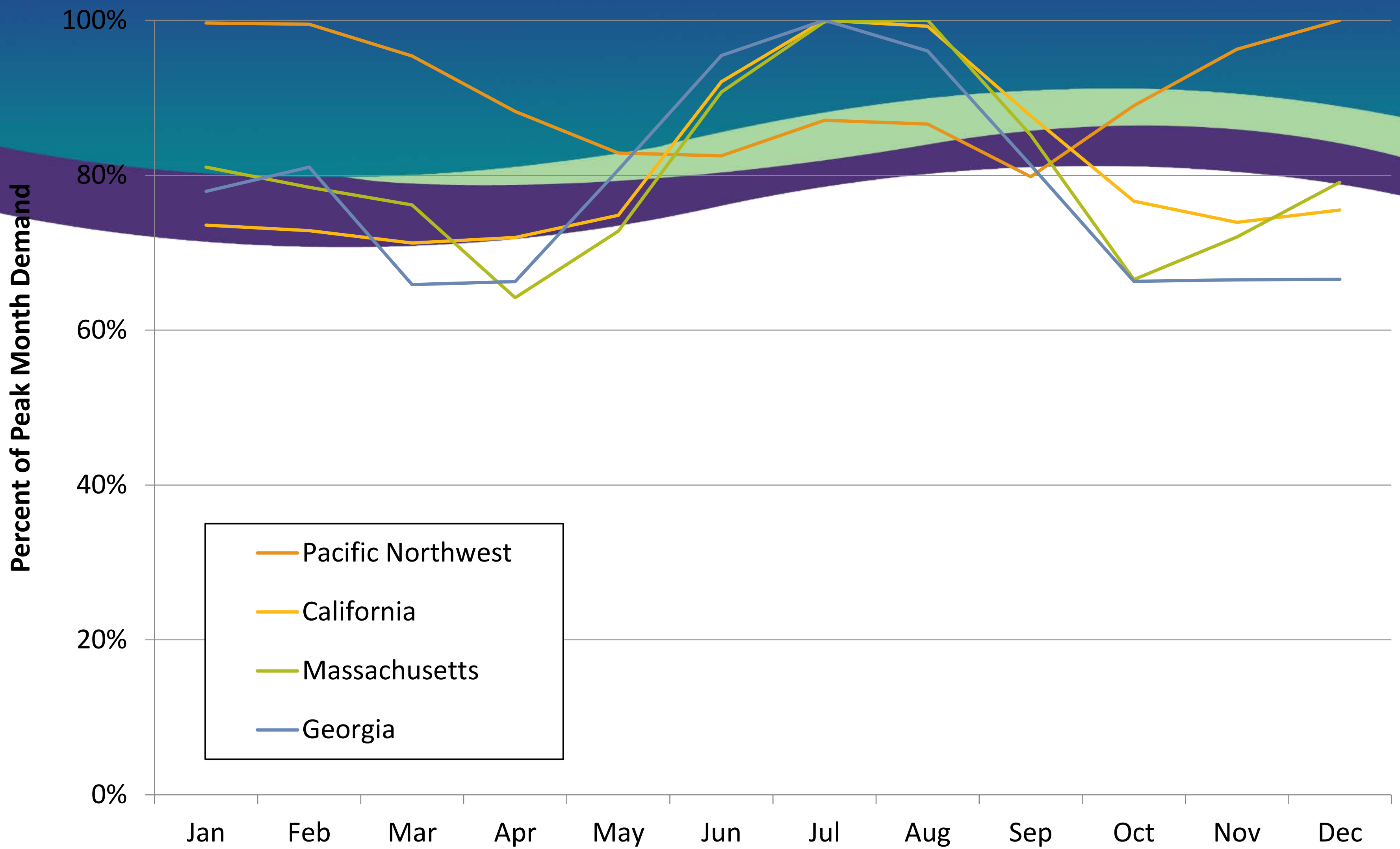
End-use Load Shapes and Energy Savings Shapes

- Definitions:
  - **End-use load shape:** Hourly consumption of an end-use (e.g., residential lighting, commercial HVAC) over the course of one year.
  - **Energy savings shape:** The difference between the hourly use of electricity in the baseline condition and the hourly use post-installation of the energy efficiency measure (e.g., the difference between the hourly consumption of an electric resistance water heater and a heat pump water heater) over the course of one year.
- The time pattern of savings from the substitution of a more efficient technology does not always mimic the underlying end-use.

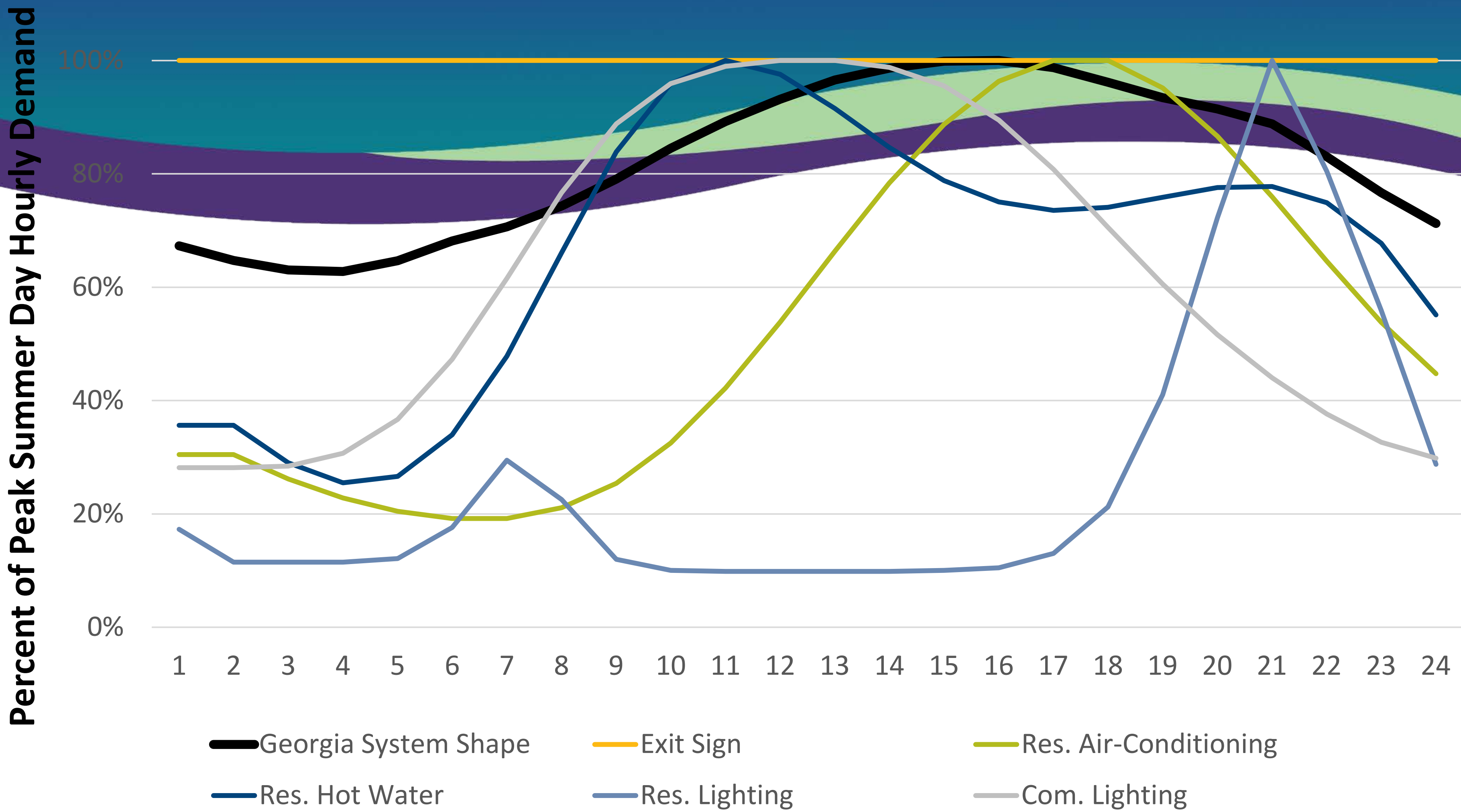
End Use vs. Energy Savings Load Shapes



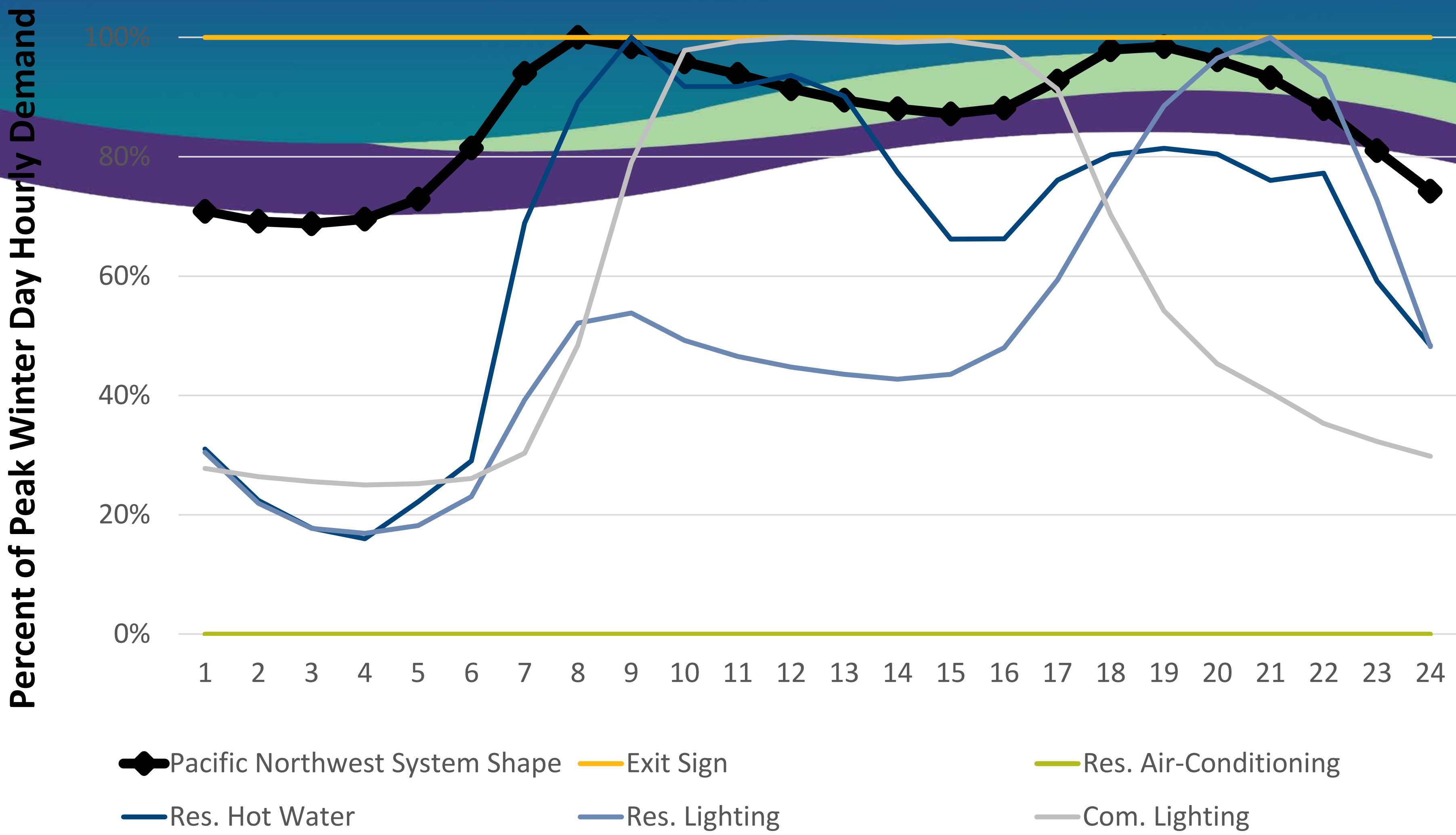
2016 System Load Shapes



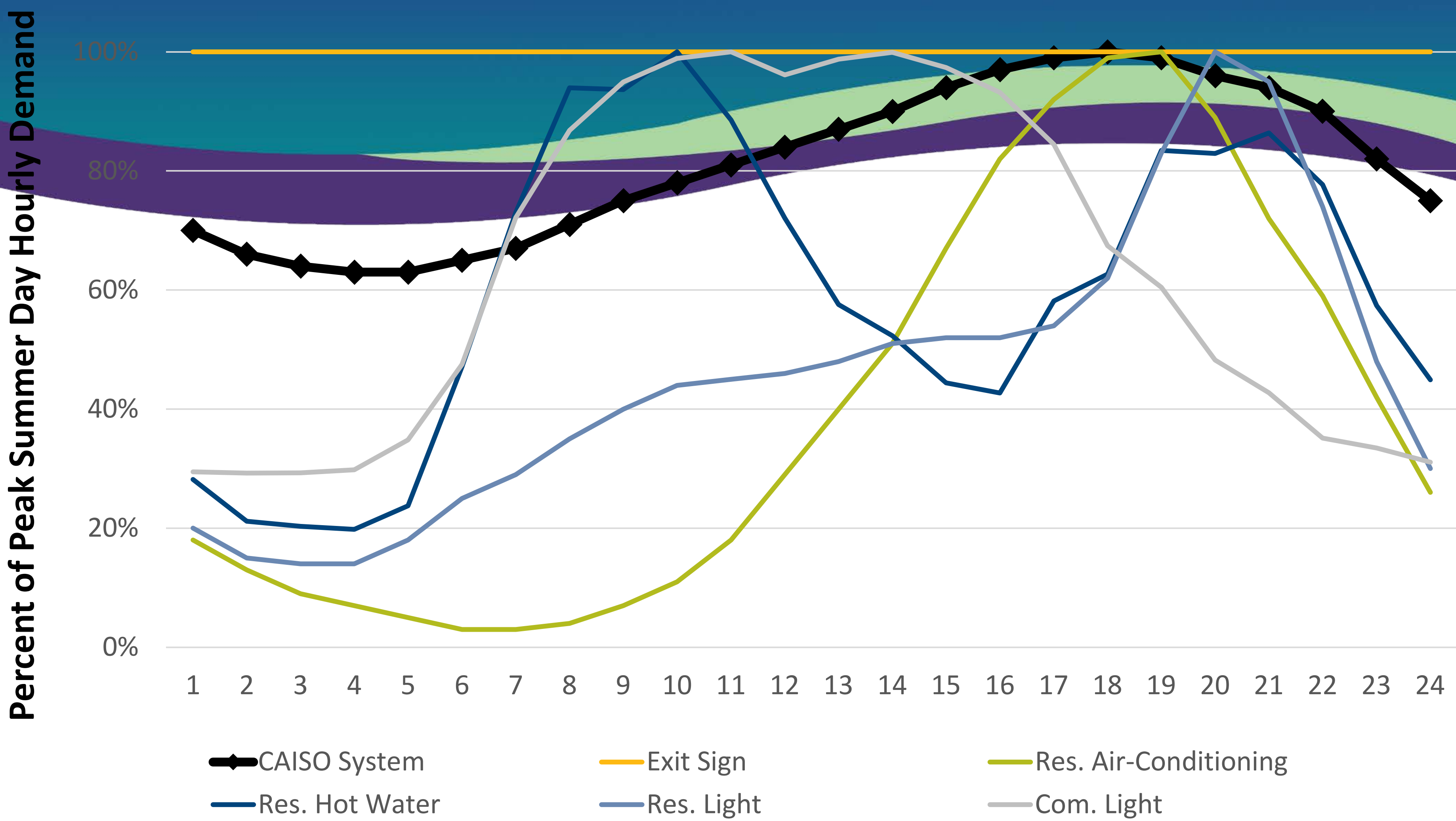
Georgia System Shape and End-Use Load Shapes



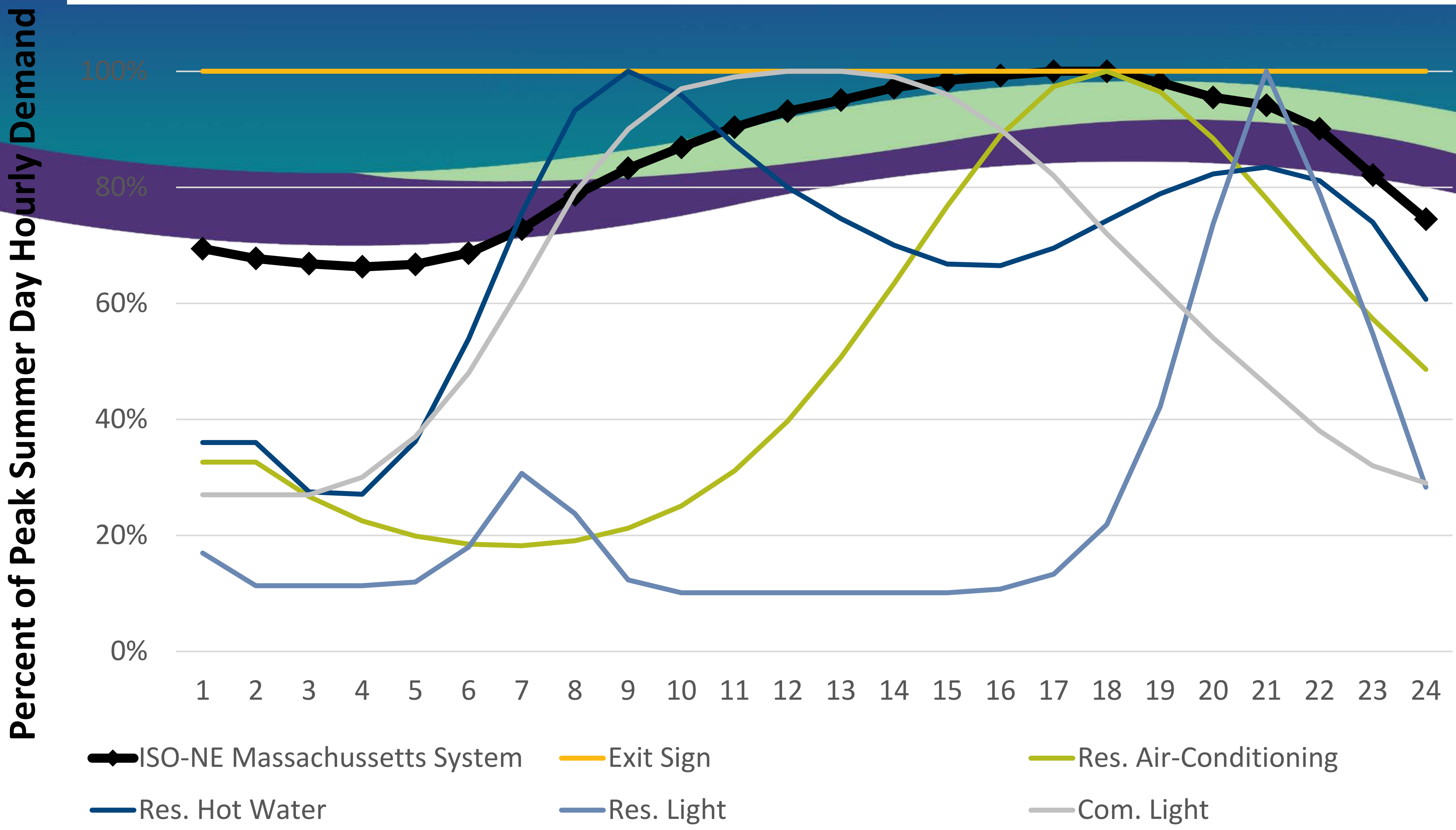
Pacific Northwest System Shapes and End-Use Load Shapes



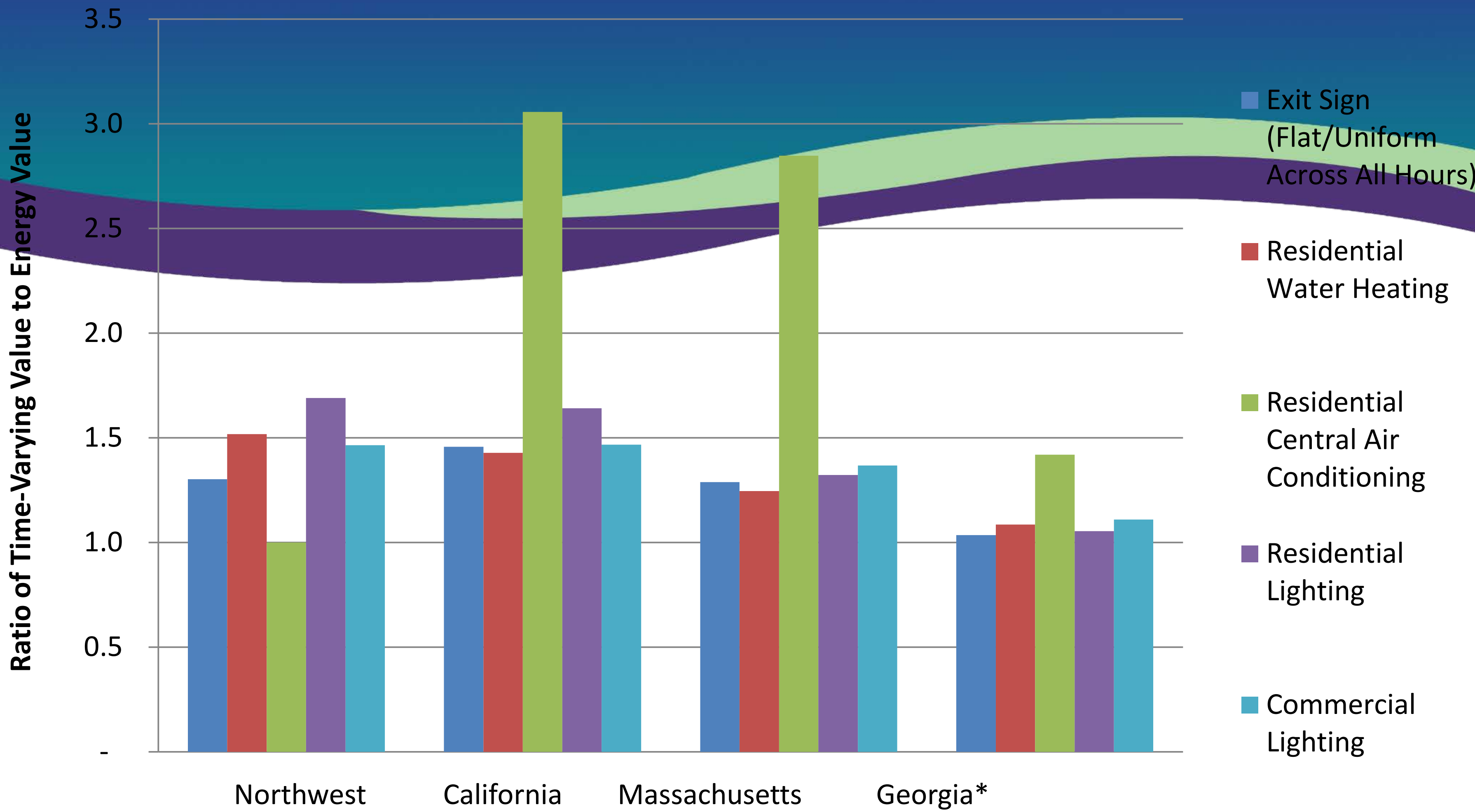
California System Shape and End-Use Load Shapes



Massachusetts System Shape and End-Use Load Shapes



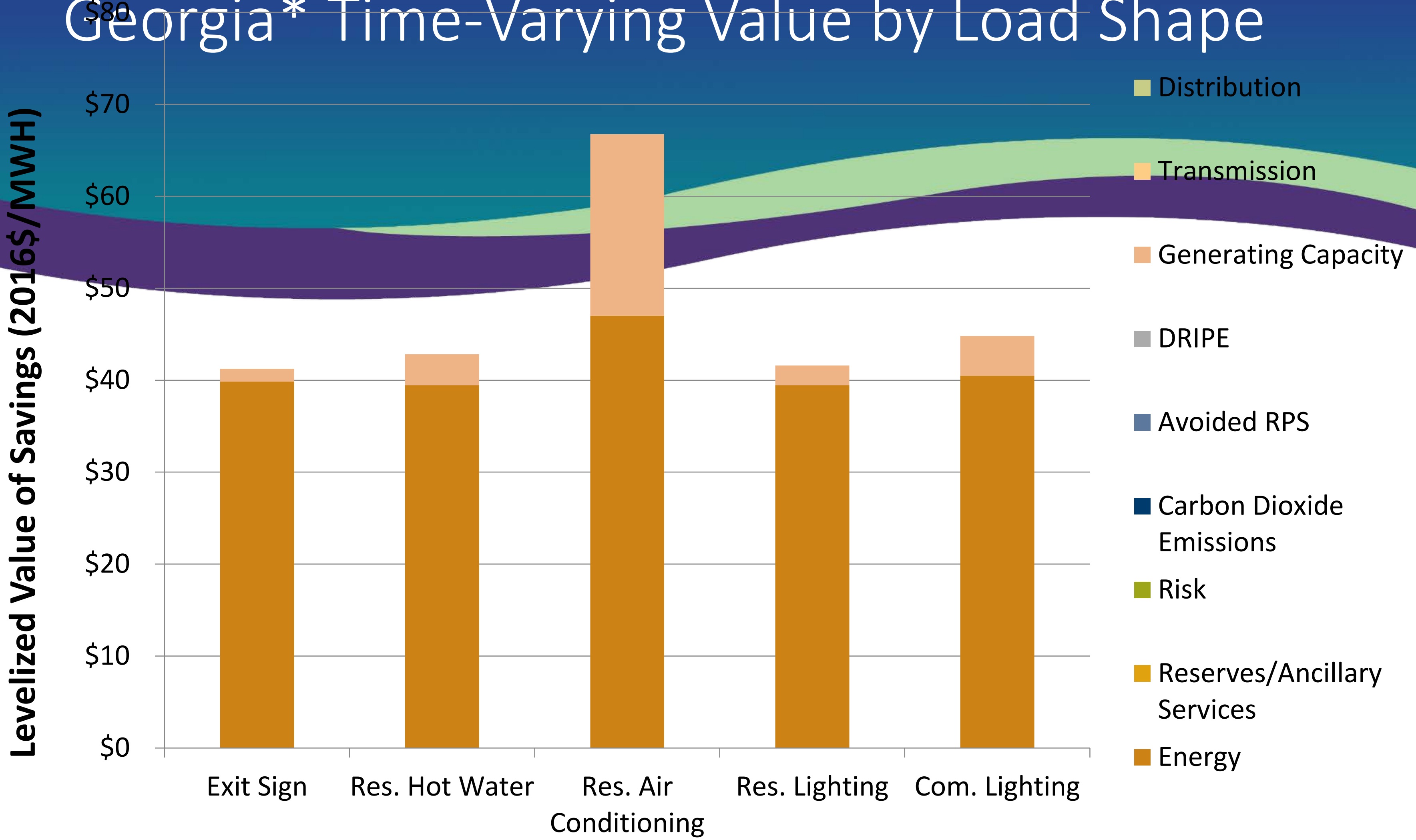
Comparing Total Utility System Value to Energy Value



Notes: The flat load shape is an exit sign. Energy value includes: energy, risk, carbon dioxide emissions, avoided RPS and DRIPE, as applicable. Total time-varying value includes all energy values and capacity, transmission, distribution and spinning reserves. Ratios are calculated by dividing total time-varying values by energy-only values.

* In Georgia, where publicly available data did not include avoided transmission and distribution system values, the time-varying value of efficiency appears much lower for all measures evaluated. Avoided transmission and distribution costs are included in Georgia Power's energy efficiency evaluations, but are not a part of the publicly available PURPA avoided cost filing.

Georgia* Time-Varying Value by Load Shape



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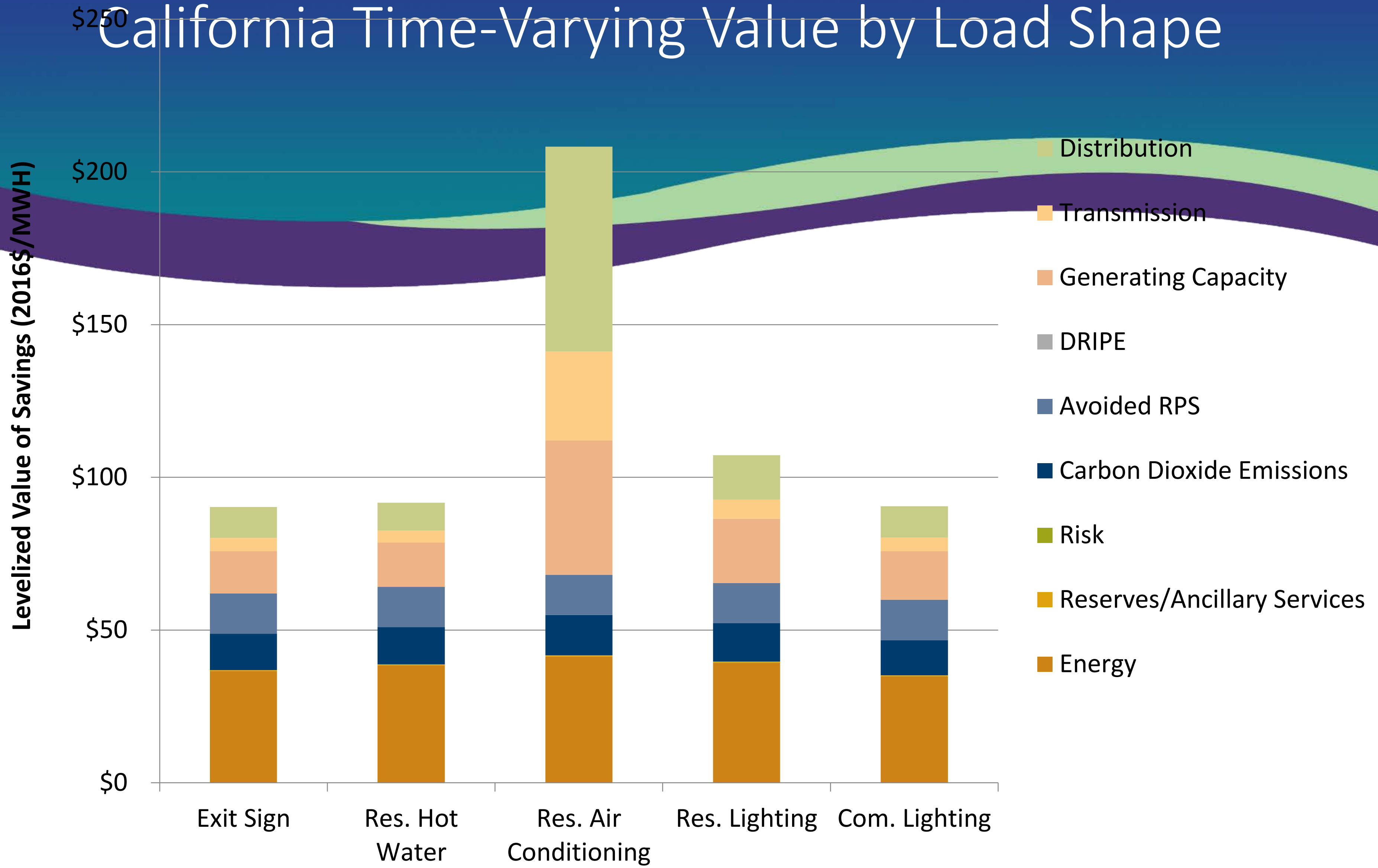
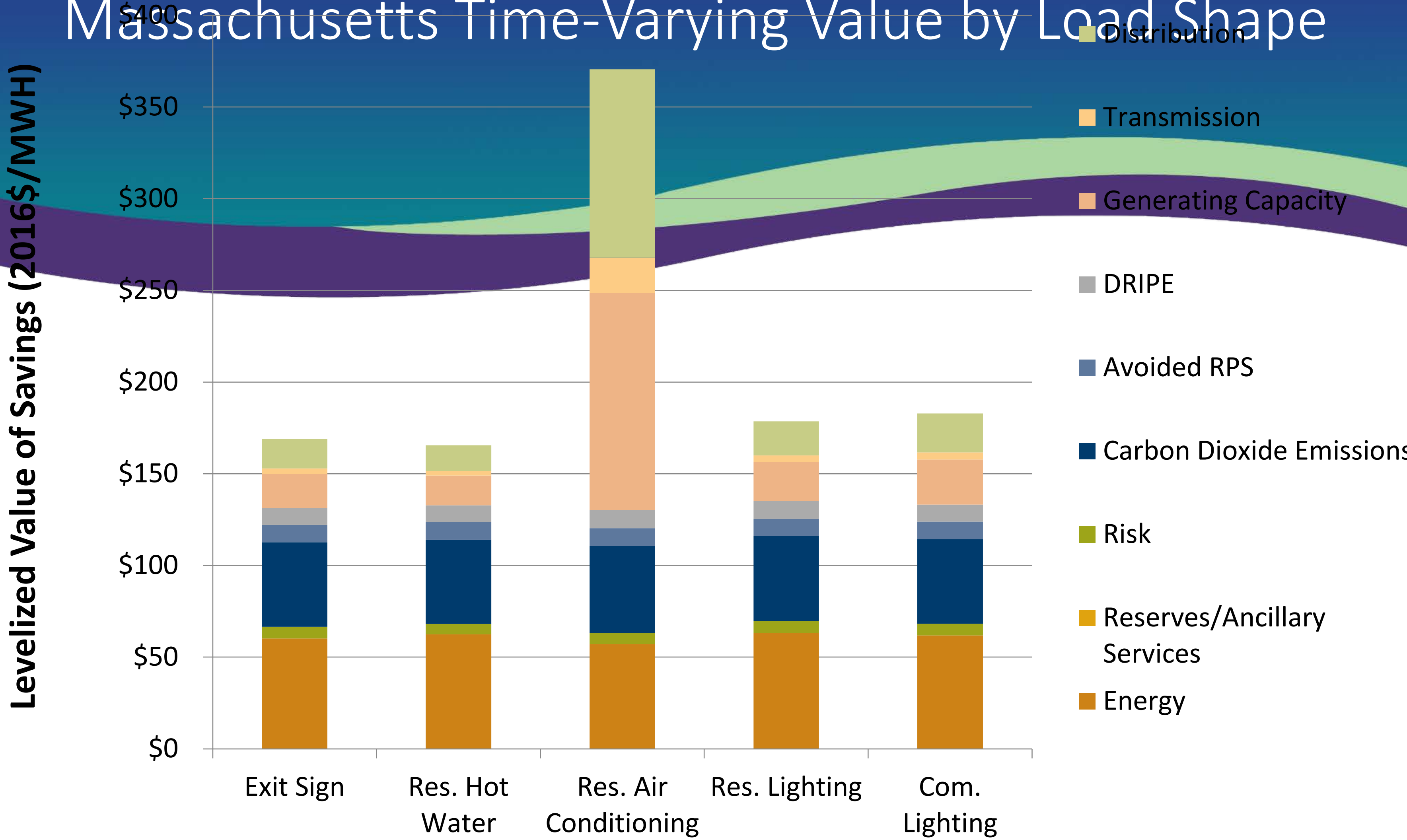
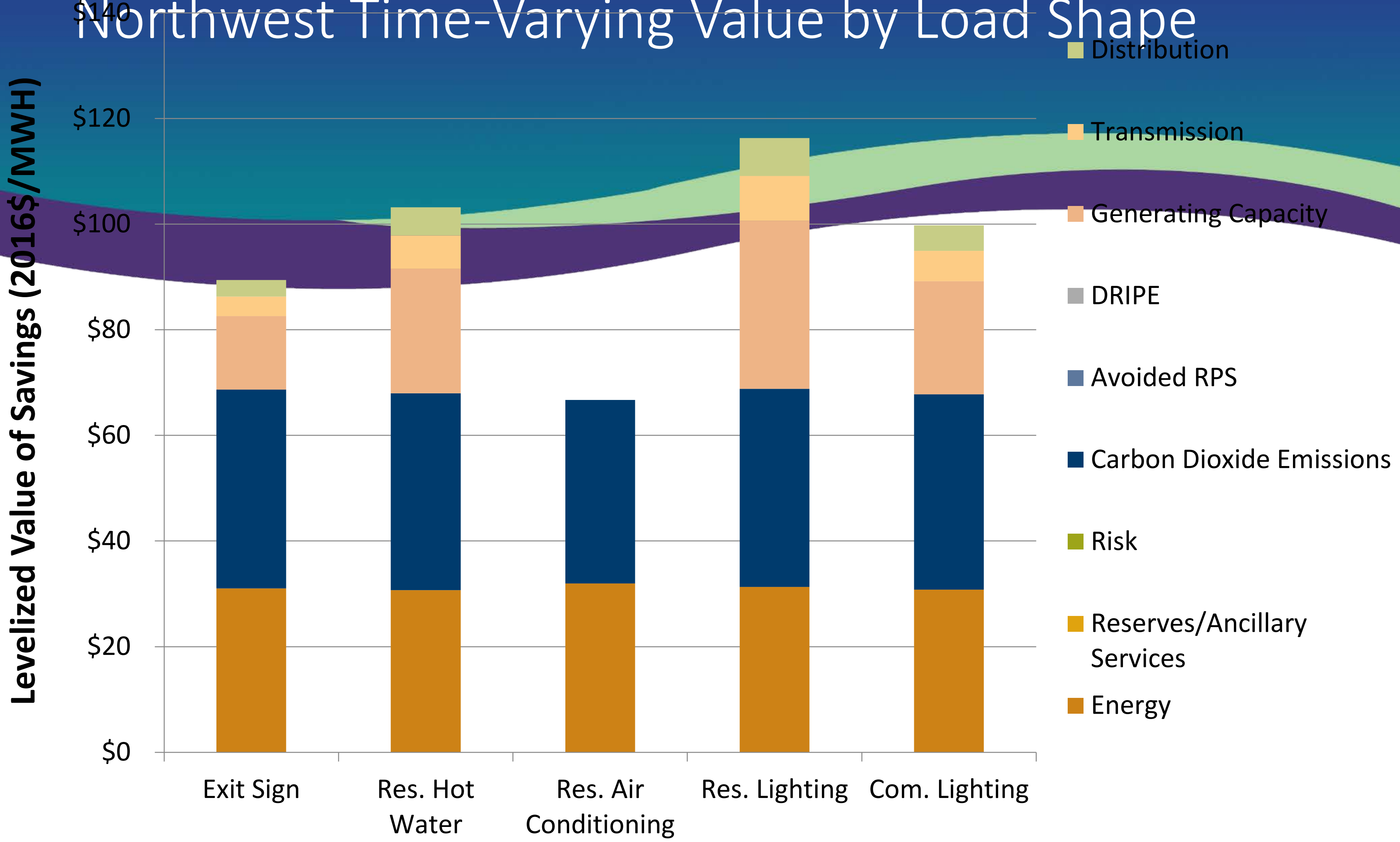
California Time-Varying Value by Load Shape



Massachusetts Time-Varying Value by Load Shape



Northwest Time-Varying Value by Load Shape



Conclusions

- Electric energy efficiency resources save energy and may reduce peak demand.
- The time-varying value of energy efficiency measures varies across the locations studied because of physical and operational characteristics of the individual utility system, the time periods that the savings from measures occur and differences in the value and components of avoided cost considered.
- Across the four locations studied, some of the largest capacity benefits from energy efficiency are derived from the deferral of transmission and distribution system infrastructure upgrades. However, the deferred cost of transmission and distribution infrastructure upgrades also exhibited the greatest range in value of all the components of avoided cost across the locations studied.
- Of the five measures studied, residential air-conditioning has the most significant added value when the total time-varying value is considered in summer peaking systems.

Conclusions (cont'd)

- The increased use of distributed energy resources and the addition of major new electricity consuming end-uses are anticipated to significantly alter the load shape of many utility systems in the future.
- Data used to estimate the impact of energy efficiency measures on electric system peak demands will need to be updated periodically to accurately reflect the value of savings as system load shapes change.
- Publicly available components of electric system costs avoided through energy efficiency are not uniform across states and utilities. Inclusion or exclusion of these components and differences in their value affect estimates of the time-varying value of efficiency.
- Publicly available data on end-use load and energy savings shapes are limited, concentrated regionally, and should be expanded.

Utility, State or Regional Recommendations

- Collect metered data on a variety of end-use load and energy savings shapes for the state or region at least at the hourly level and make the data publicly available in a format that can be readily used in planning processes.
- Account for variations in the calculation of time-varying value of energy savings and avoided costs.
- Periodically update estimates of the impact of energy efficiency measures on utility system peak demands to accurately reflect changing system load shapes.
- Study transferability of end-use load shapes from one climate zone to another climate zone.

Regional or National Recommendations

- Identify best practices for establishing the time-varying value of energy efficiency in integrated resource planning and demand-side management planning to ensure investment in a least-cost, reliable electric system.
- Establish protocols for consistent methods and procedures for developing end-use load shapes and load shapes of efficiency measures.
- Establish common methods for assessing the time-varying value of energy savings, including values that are often missing such as deferred or avoided T&D investments.

Natalie Mims
namims@lbl.gov
510-486-7584

Tom Eckman
teckman49@gmail.com
503-803-5047

Chuck Goldman
cagoldman@lbl.gov
510-486-4637

Lisa Schwartz
lcschwartz@lbl.gov
510-486-6315

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Valuing Energy Efficiency for Meeting Emerging Grid and Customer Needs

Georgia Power
October 17, 2017

Georgia Power at a glance

- Georgia Power is an investor-owned electric utility
  - ~ 2.5 million retail electricity customers
  - > $8 billion in annual revenue
  - > 15,000 MW of generation capacity
  - > 12,000 miles of transmission lines
  - > 75,000 miles of distribution lines
- 2016 Energy mix:
  - 47% gas, 29% coal, 20% nuclear, 4% hydro/renewables
- Retail electricity business regulated by the Georgia Public Service Commission

Georgia PSC – Integrated Resource Plan

- Triennial Integrated Resource Plan
  - First one in 1992, every three years thereafter
  - 20-year outlook of customer needs and how to serve them
    - Supply side including utility-scale generation, distributed generation, transmission, and distribution considerations
    - Demand side including energy efficiency and demand-response programs
- DSM Program Planning Process includes:
  - Evaluate energy efficiency measures
    - Qualitative screen
    - Quantitative screen
    - TRC-passing measures considered for programs
  - Collaborative process with members of the DSM Working Group
  - DSM Plan balances economic efficiency and rate impacts
    - Balance between TRC benefits and RIM impacts
- Highlights from the 2016 IRP:
  - Certified energy efficiency programs for residential and commercial
  - Technical Reference Manual will replace DSM Technology Catalog
  - Technical, Economic, and Achievable Energy Efficiency Potential Study

Georgia Power Energy Efficiency Evaluations

- Marginal economic analysis
  - Evaluate changes in marginal revenue and marginal costs
- Hourly load profiles for customer usage
  - With and without energy efficiency measures on an hourly basis
- Economic analysis conducted on over 400 individual energy efficiency measures
  - Across multiple applicable customer segments
  - Base and change case method
  - Several thousand individual cases evaluated

"Benefits" of Hourly Marginal Analysis

- Average rates and average avoided costs are not the same as marginal
  - Average method can understate or overstate impacts
- Marginal revenue impacts
  - Increasing or declining block rate structures
  - Billing demand rate structures
- Marginal production cost impacts
  - Generation, transmission, and distribution impacts depend on hourly profile of energy savings
  - Fuel cost savings vary by hour
- Demand-side and supply-side evaluated consistently
  - Close coordination with generation, transmission, and distribution system planners

“Costs” of Hourly Marginal Analysis

- Develop hourly energy profiles at the customer and measure level
  - Load research data or energy simulation software
  - Numerous individual analyses

- Develop and maintain hourly production costing models
  - Rigorous and detailed modeling of very small impacts to utility system, including generation, transmission, and distribution
  - Numerous individual analyses

Value of Marginal Analysis to Georgia Power

- Decision-making is based on marginal analysis
  - For demand-side and supply-side
- DSM Program Cost-Effectiveness Tests
  - TRC, RIM, PT, PACT all based on marginal analysis
- Energy efficiency program impacts are important
  - Included in the load and energy forecast
  - Included in the generation expansion plan
  - Included in the financial plan

Emerging Grid and Customer Needs

- Hourly marginal analysis necessary for emerging needs
  - Demand-response programs
  - Behind-the-meter solar
  - Distributed energy resources
  - Battery storage
  - Beneficial Electrification
    - Electric vehicles
    - Fuel-switching

Georgia Power

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Faces of EE

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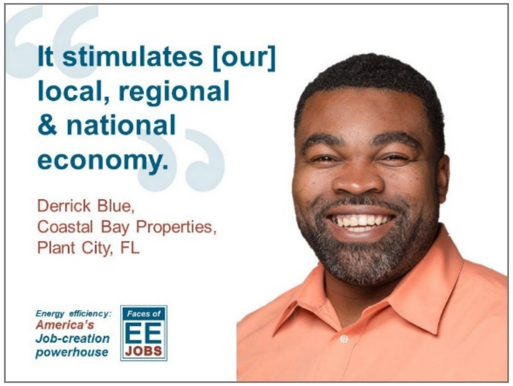

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