2009 ACEEE 5TH NATIONAL CONFERENCE ON
ENERGY EFFICIENCY AS A RESOURCE

ECONOMIC EFFICIENCY POTENTIAL OF NEW AND EXISTING BUILDINGS

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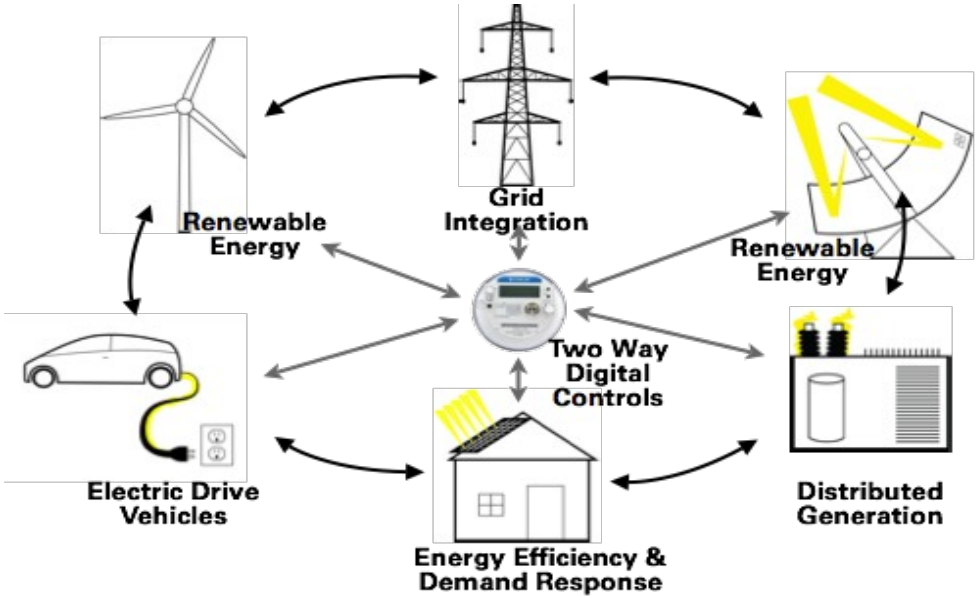
A low carbon electric system is needed, and is feasible

Vision

A no-carbon electric system that is cost-effective, reliable, secure, and environmentally sound.

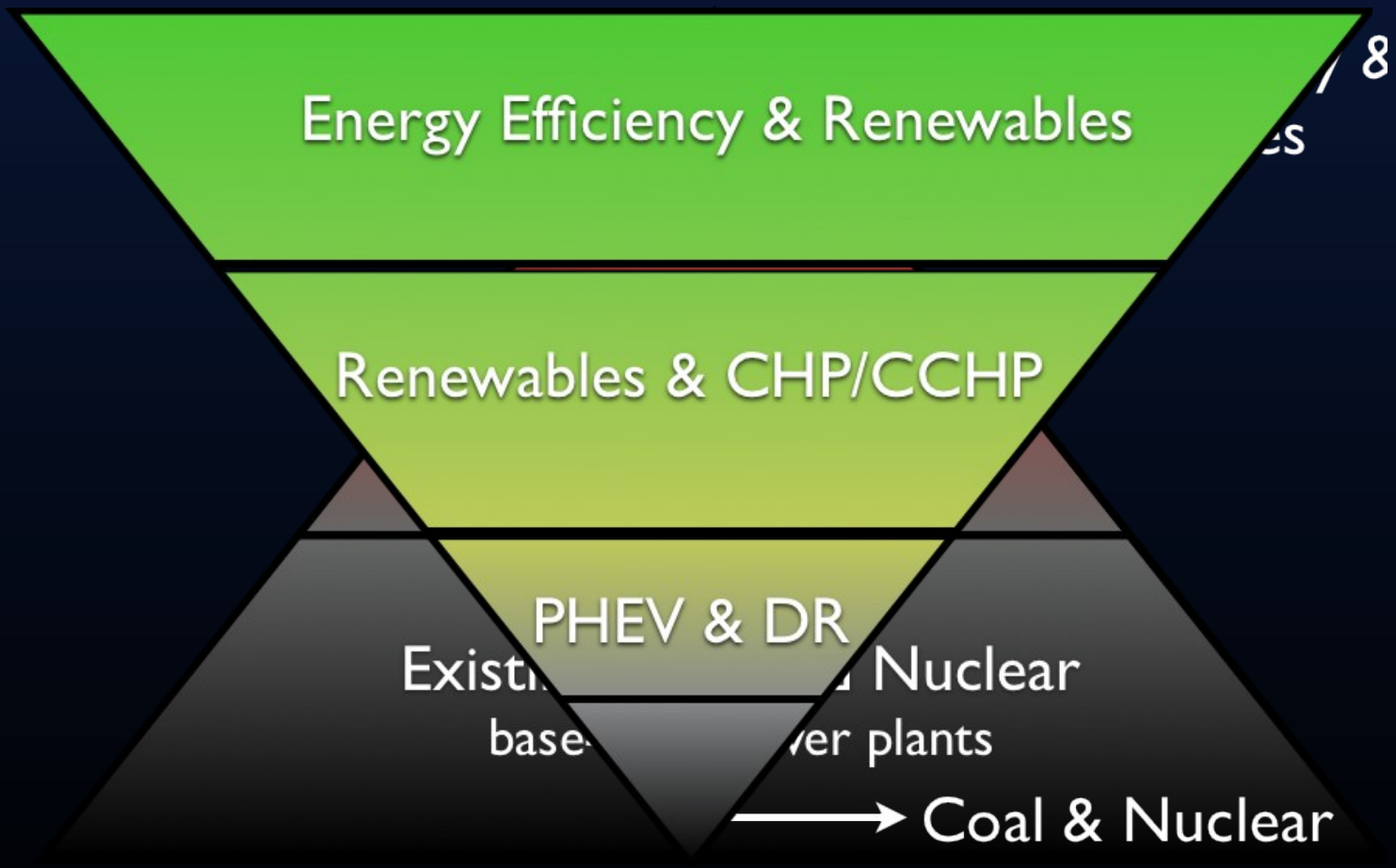
Components



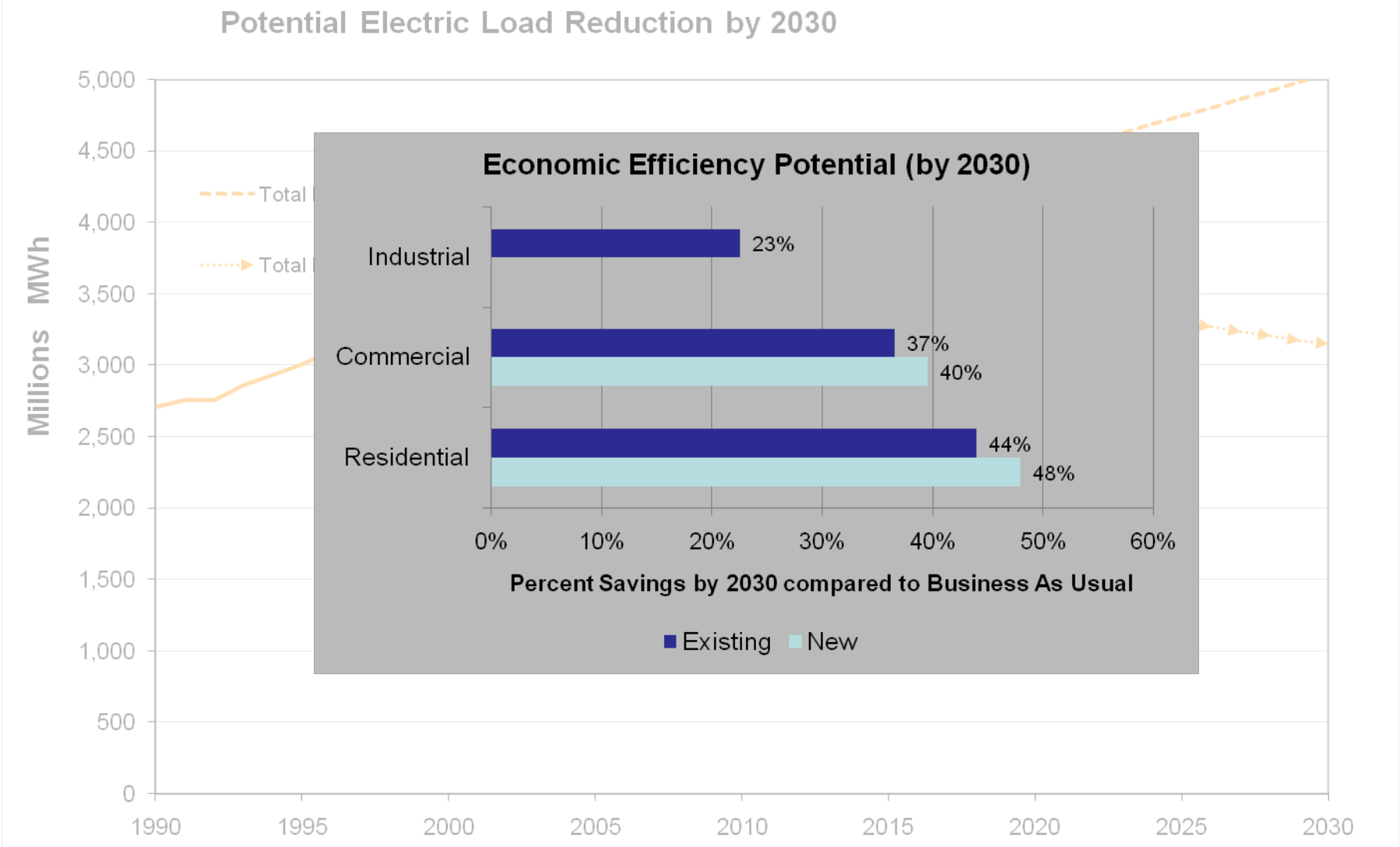
Benefits

- Eliminate electric system contribution to **climate change**
- **Central to "New Energy Economy" based on renewable resources**
- **Create jobs** in areas ranging from efficiency retrofits to high tech
- Increased **power system reliability** and reduced risk of disruptions

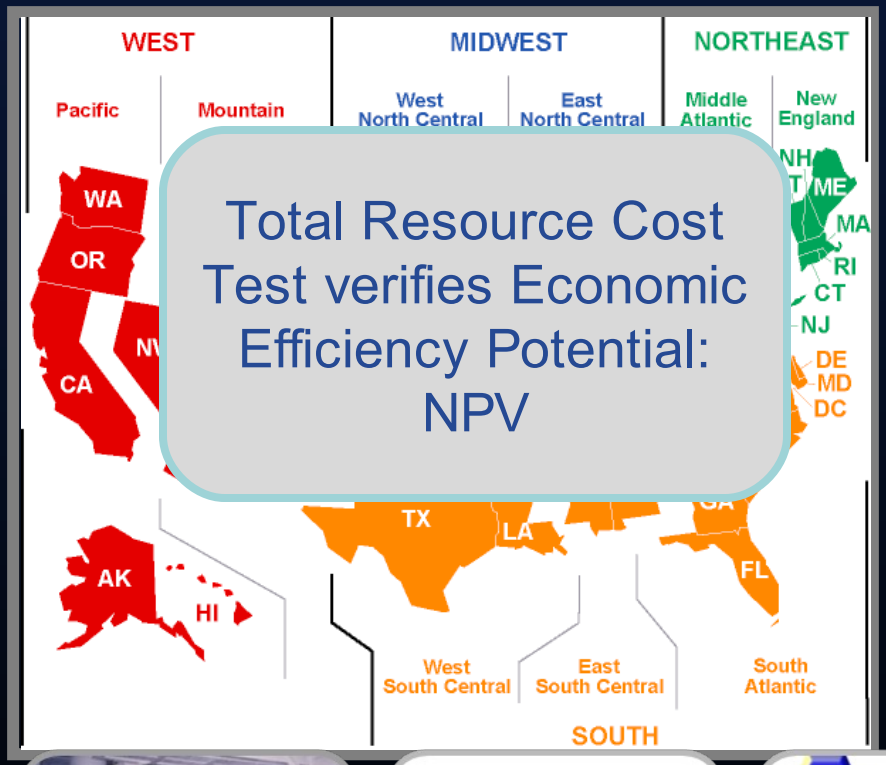
Energy efficiency is the keystone resource of the low-carbon utility



Our research in the past year shows that it is economic to flatten load growth even in the reference efficiency scenario



In deriving these results we took a bottom-up, integrated system approach

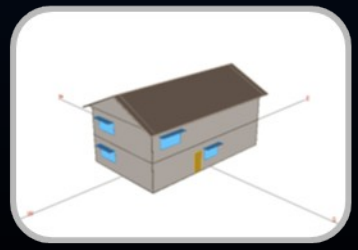


Existing Commercial

Existing Residential

Existing Industrial

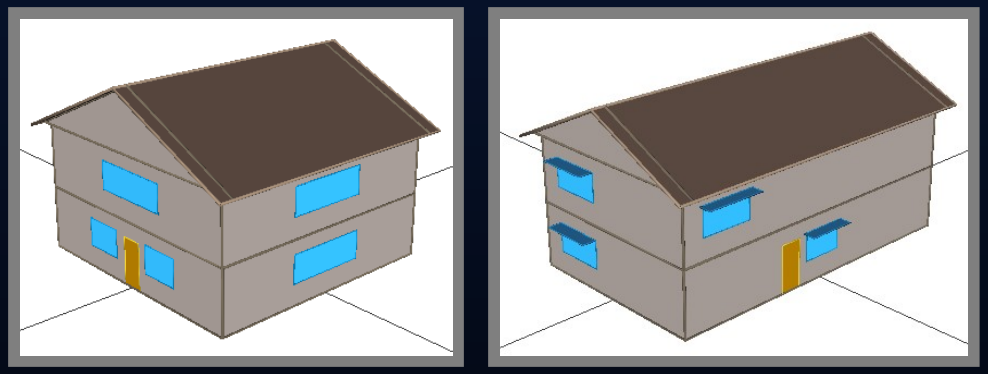
New Commercial

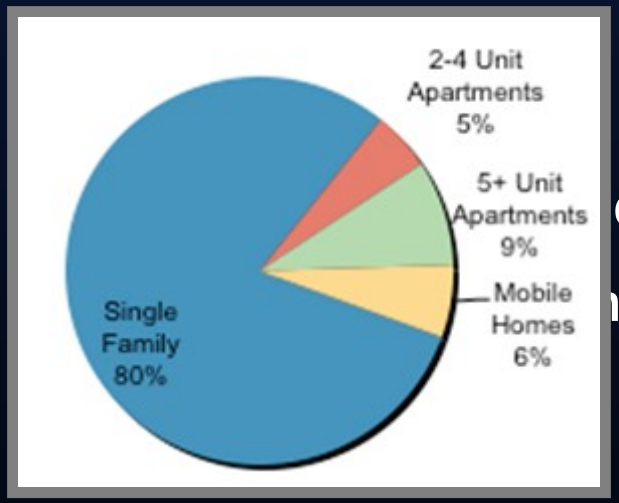


New Residential

New Residential Methodology

Whole Systems Design





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Baseline

- IECC 2003
- NHBA
- Building Energy Databook

New Commercial Methodology

Case Studies

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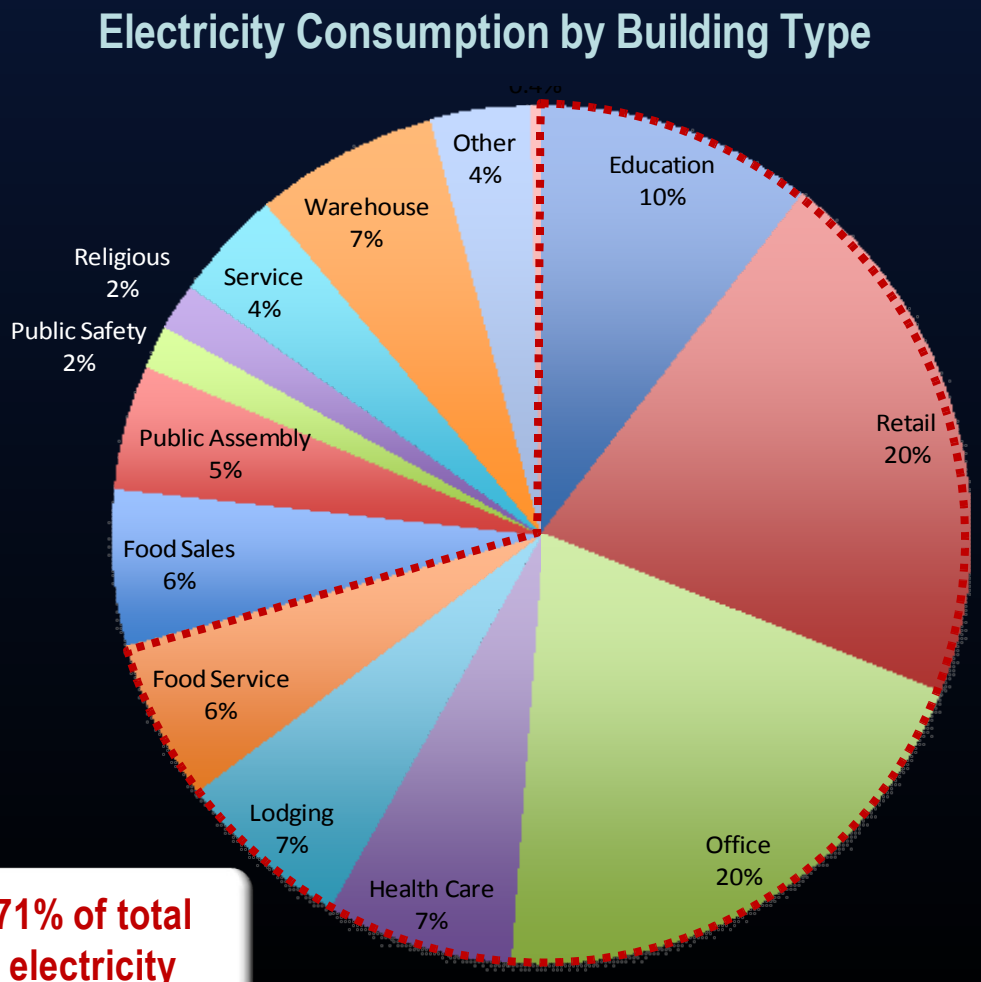
Savings by End Use

↓

Correct for Plug Load Savings

↓

Normalize to ASHRAE 90.1-2004



71% of total electricity

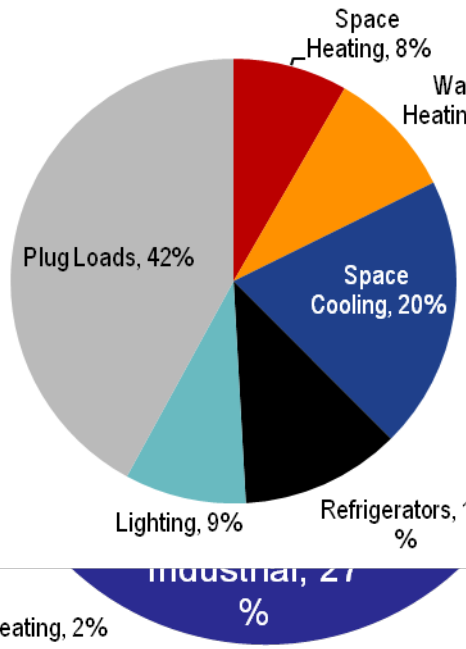
Existing Building Methodology

Identify EEMs by End Use → Determine Average Baseline → Calculate Potential Savings → Pass TRC Cost Test?

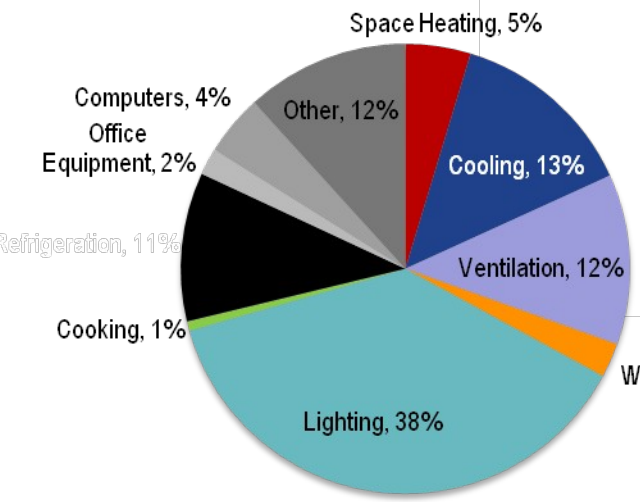
YES → Determine "Percent Applicability" → Apply to climate zones (except Industrial)

NO → Identify EEMs by End Use

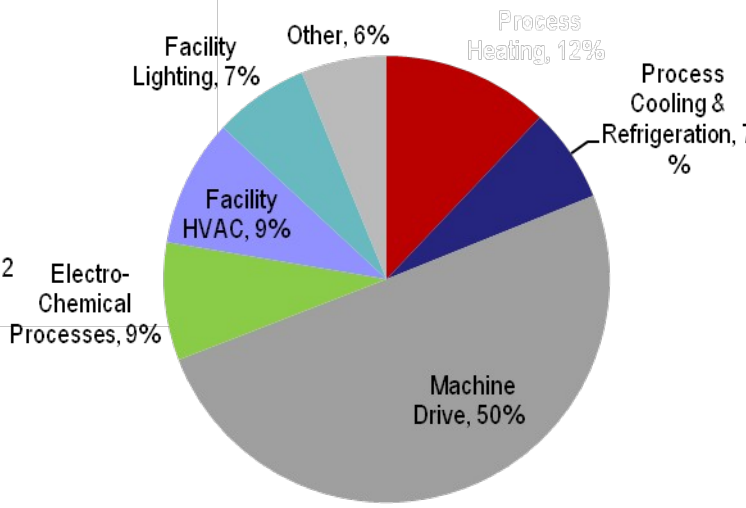
Residential



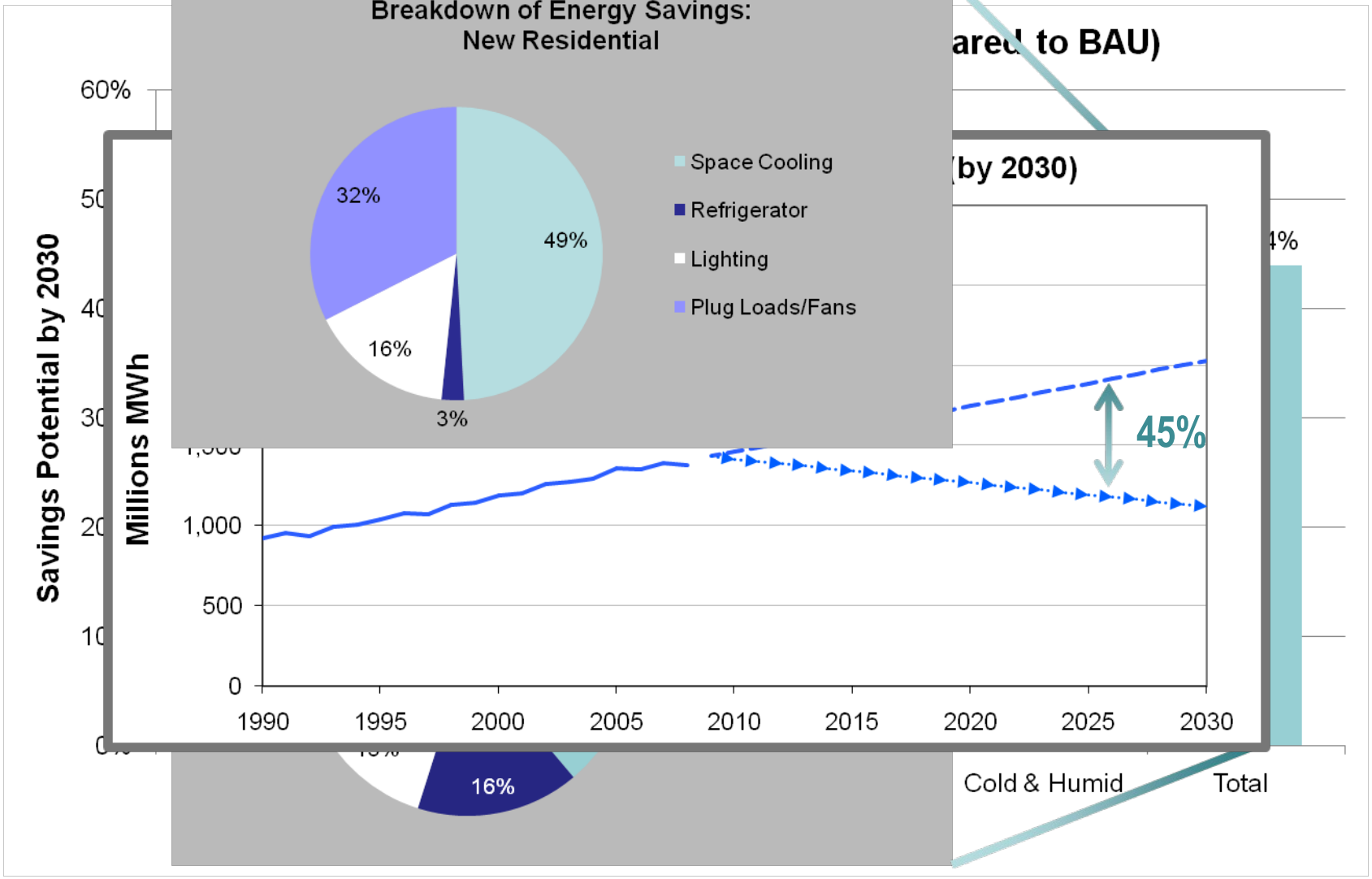
Commercial



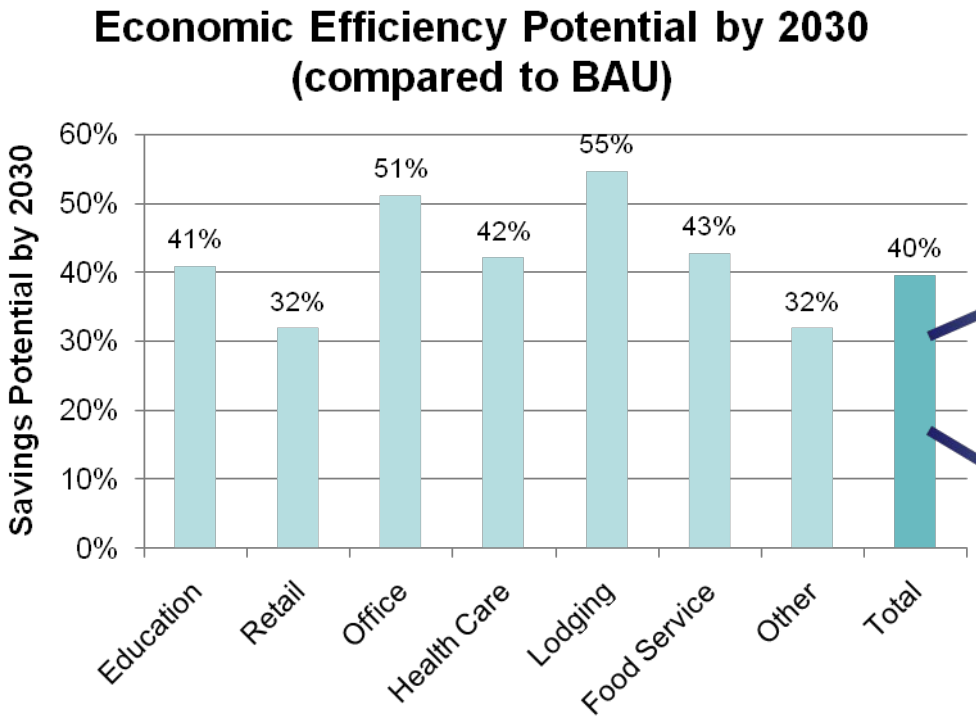
Industrial

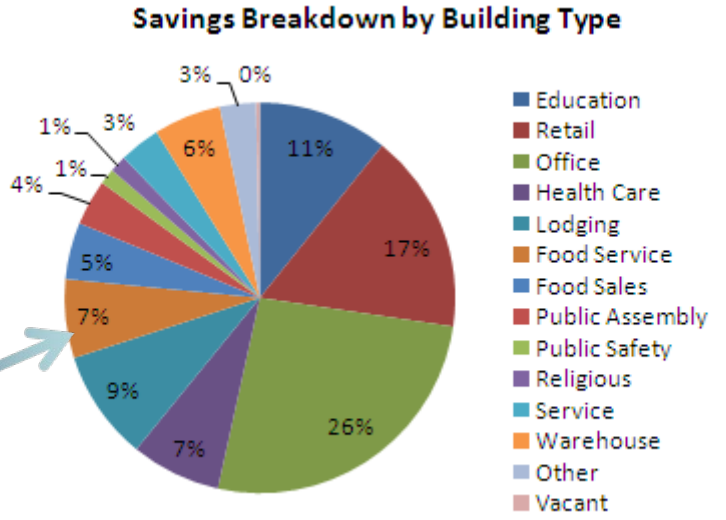


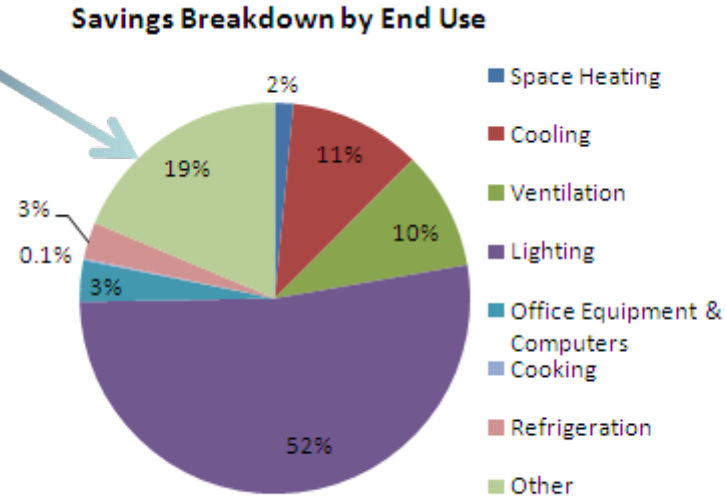
Economic Efficiency Potential: Residential



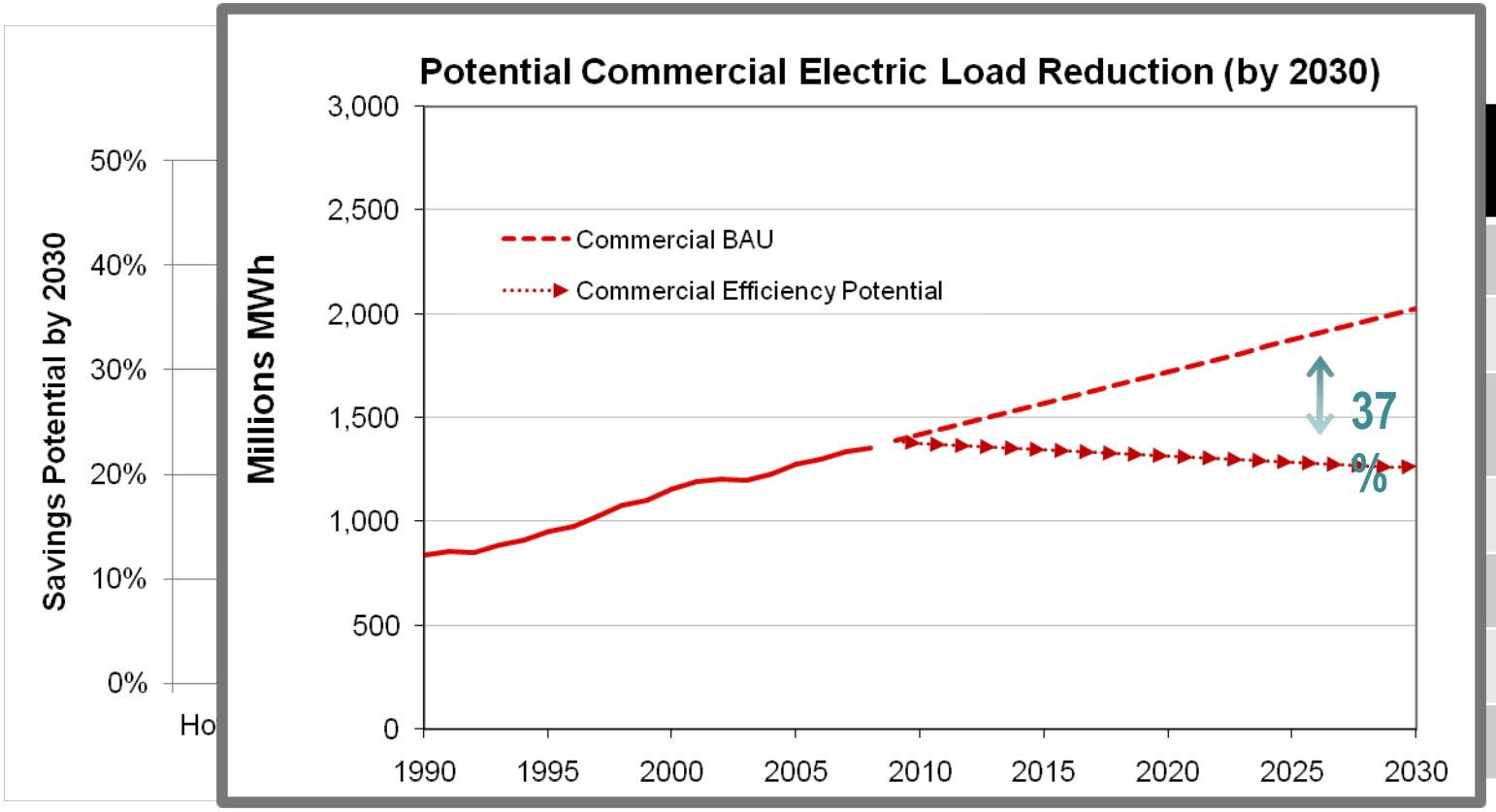
Economic Efficiency Potential: New Commercial







Economic Efficiency Potential: Existing Commercial



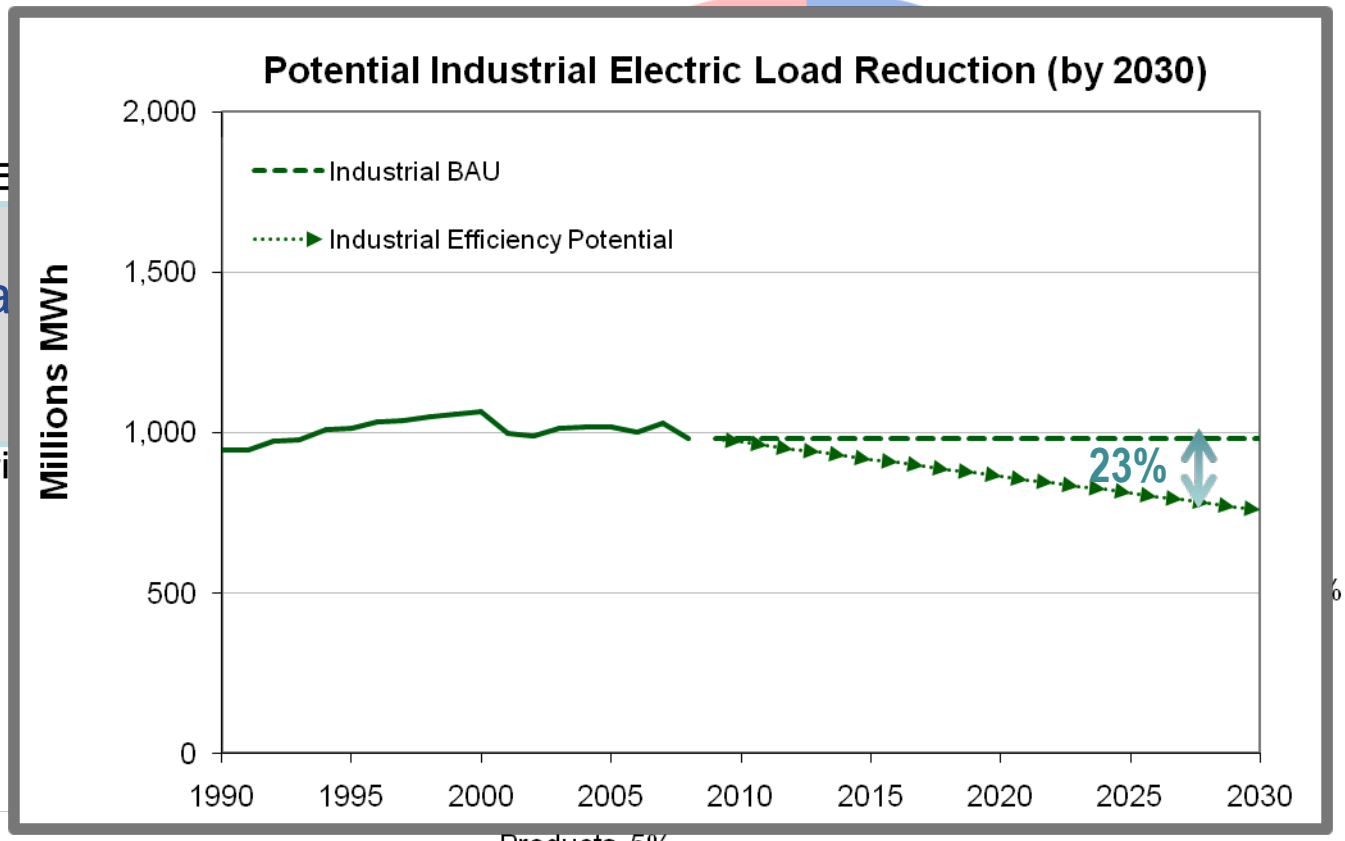
	Potential Savings
	58%
	42%
	40%
	28%
	48%
	30%
	40%

Economic Efficiency Potential: Industrial

23% Tota
Savings

Refri

Agricultural, 6%



Products, 5%

The Next Generation Initiative takes a multi-dimensional approach to developing vision for a low carbon utility system

	EPRI - The Full Portfolio	Jardine - Deep Green Scenario	Galvin Initiative - Perfect Power System	McKinsey - How Much at What Cost?	World Watch - Low Carbon Energy
Type of Organization	Industry organization	Academic researcher	Non-profit coalition	For profit organization	Non-profit organization
Portfolio Approach					
Reliable Operation					
Economic Viability					
Regional Applicability					
Low Carbon Emissions					
SUMMARY					

Not Considered  Rigorously Examined

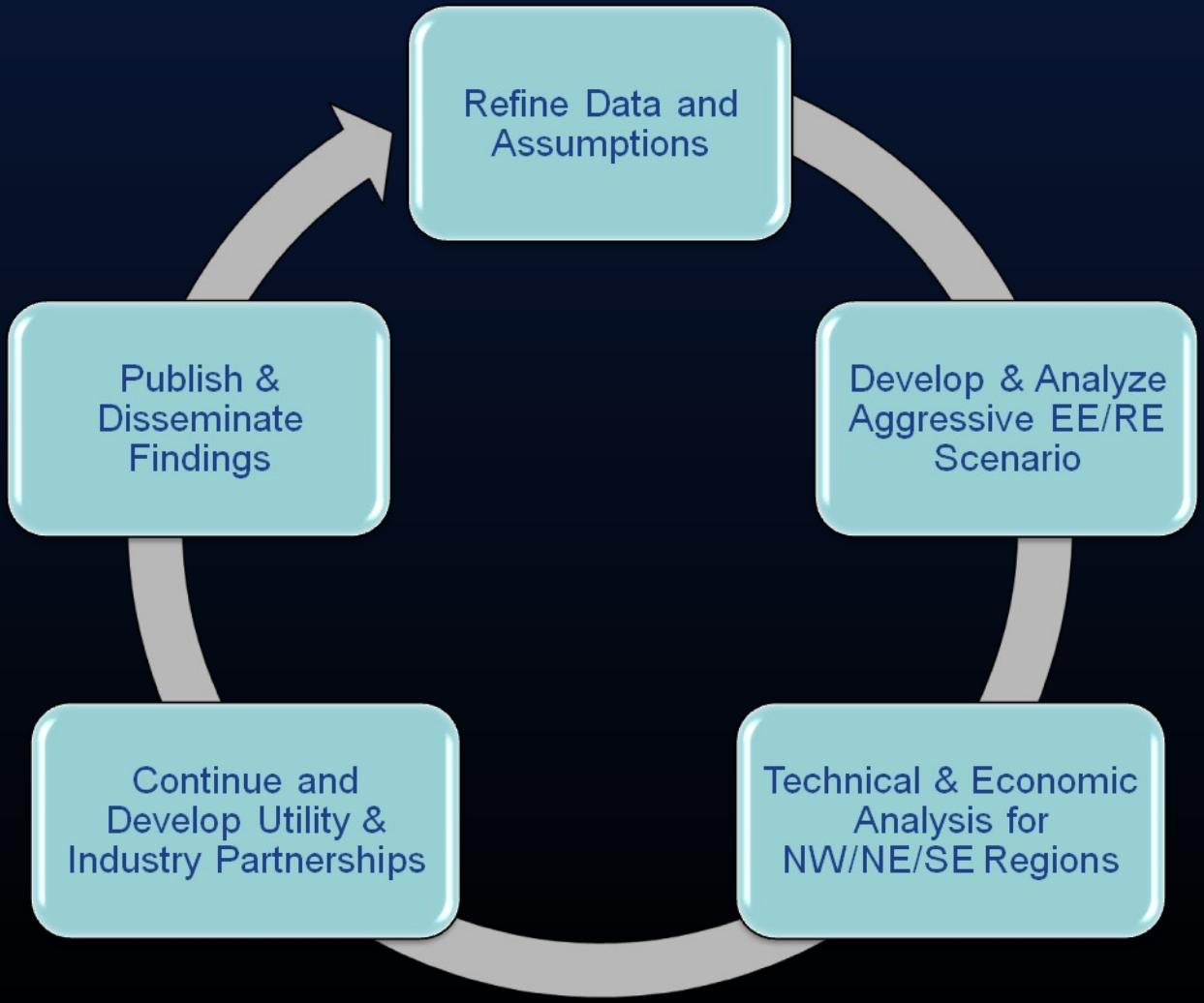
**Table represents a small sample of studies reviewed*

Studies Leave a Gap

Though there are many "visions" of future electric system, they do not fully include all available types of low carbon resources. Few if any of them connects all of the required elements of a vision through a dynamic model that provides the additional detail needed establishing credibility among utilities

Efficiency potential and results of other concurrent research are modeled and applied to real utility operations

Next Steps


Refine Data and Assumptions
Develop & Analyze Aggressive EE/RE Scenario
Technical & Economic Analysis for NW/NE/SE Regions
Continue and Develop Utility & Industry Partnerships
Publish & Disseminate Findings

Questions?

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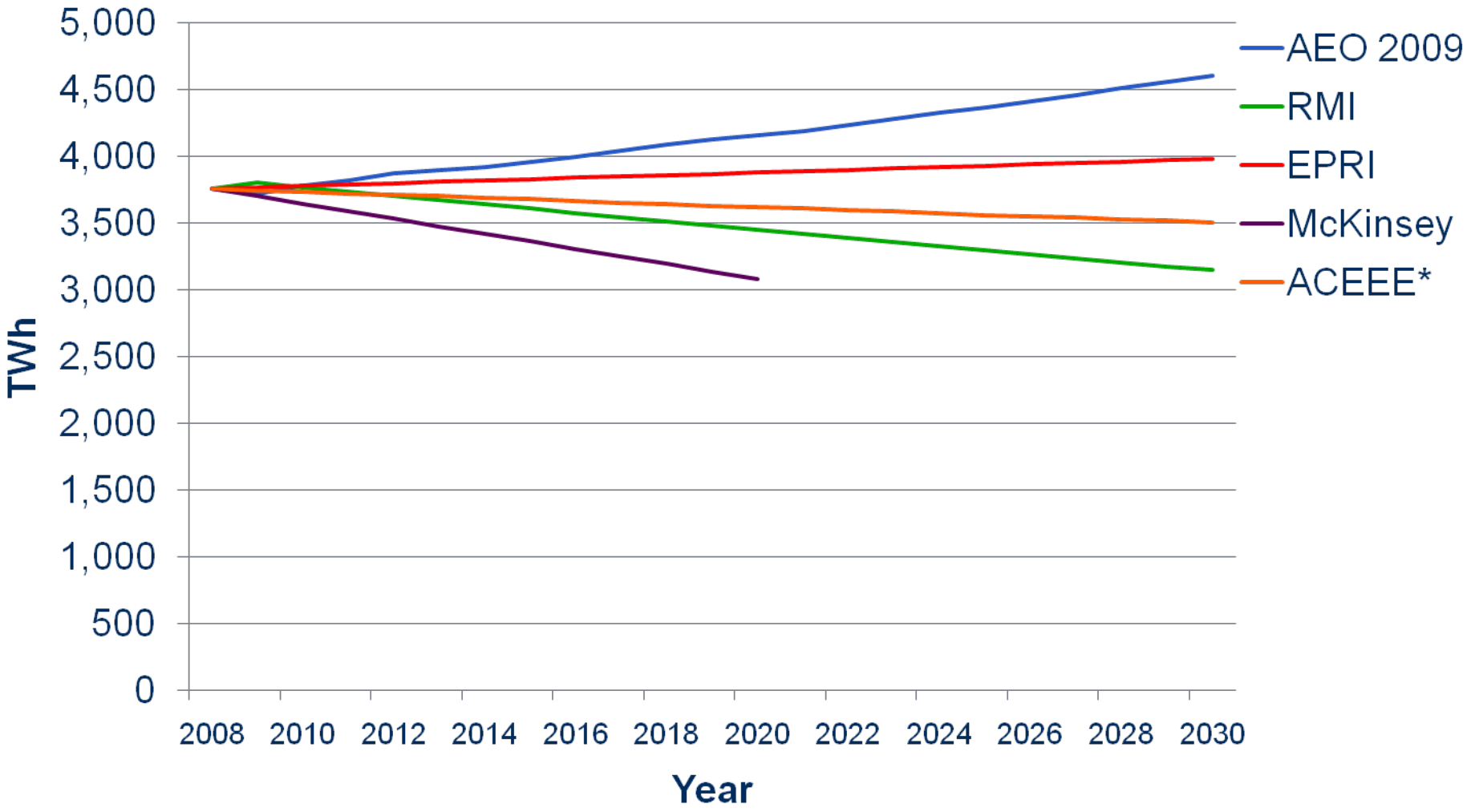
Appendix: Comparison of recent studies evaluating energy efficiency economic potential

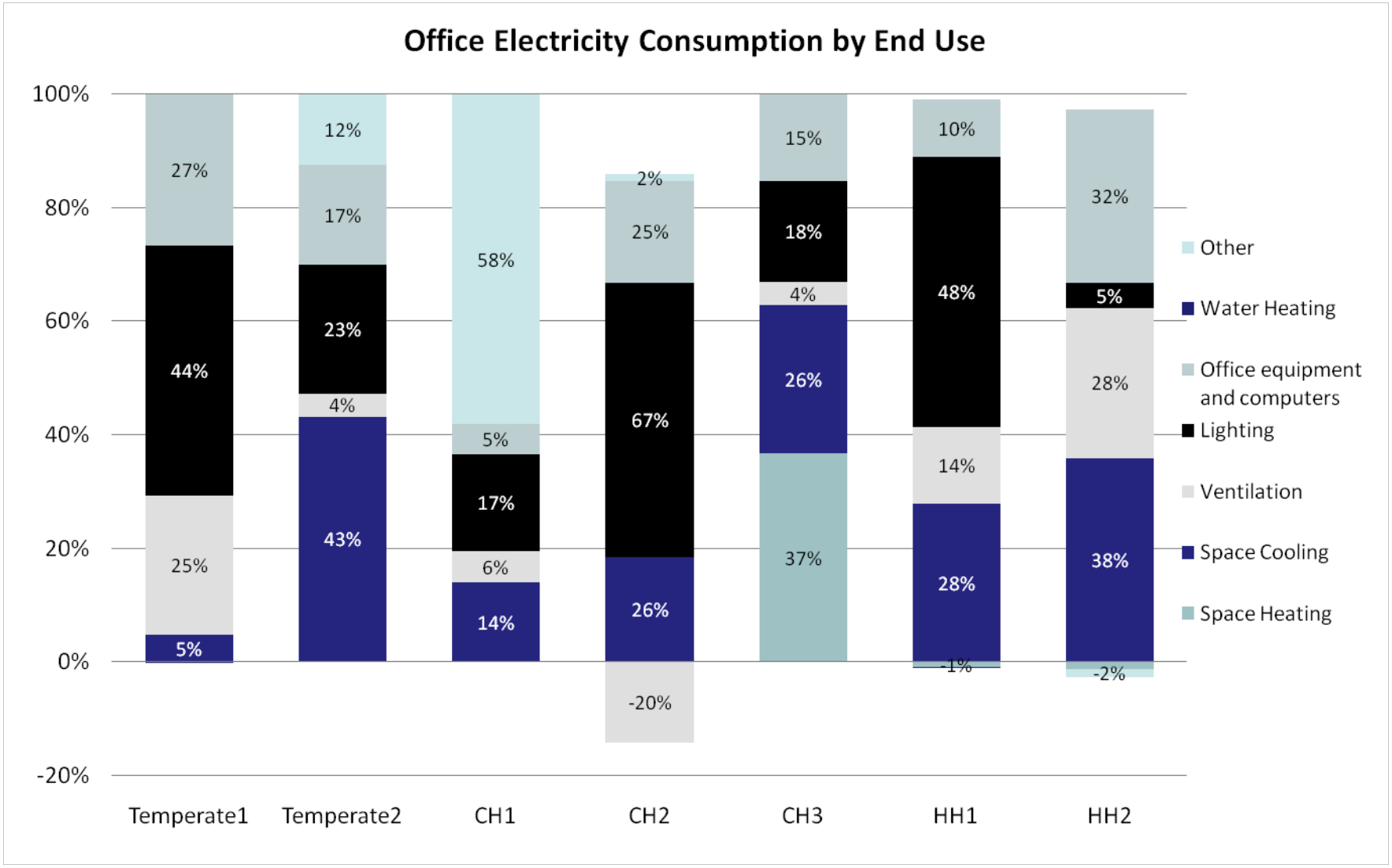


*ACEEE study based on meta-evaluation of existing state and regional studies

Appendix: Comparison of recent studies evaluating energy efficiency economic potential

Study	Economic Potential	Baseline
RMI	35.7% by 2030	Linear extrapolation of past 18 years of consumption out to 2030
EPRI	13.8% by 2030	AEO 2008
McKinsey	26% by 2020	AEO 2008
ACEEE meta-evaluation	24% by 2030	Varies by study

Appendix: Climate Zone Variation for New Commercial



Appendix: Whole Systems Design for New Residential

- **Architectural design optimized for daylighting and passive solar control/passive heating in the winter**
  - ***Floorplate oriented with long axis along East-West axis***
  - ***Overhangs for shading during the cooling loads***
  - ***Highly insulating roof, walls, slab, doors and windows***
  - ***High performance windows with a high LSG ratio***
  - ***Reflective roof and exterior walls (in cooling dominated climates)***
  - ***Tight construction to minimize infiltration***
- **CFLs for 90% of the interior lighting**
- **EnergyStar appliances and plug loads**
- **Reduction in standby power losses from plus loads**
- **Efficient space cooling solution (varies by climate)**
  - ***Natural Ventilation (Temperate and Cold & Dry Climates)***
  - ***Direct/Indirect evap cooling (Hot & Dry Climate)***
  - ***Most efficient commercially available AC unit (Hot & Humid + Cold & Humid Climates)***

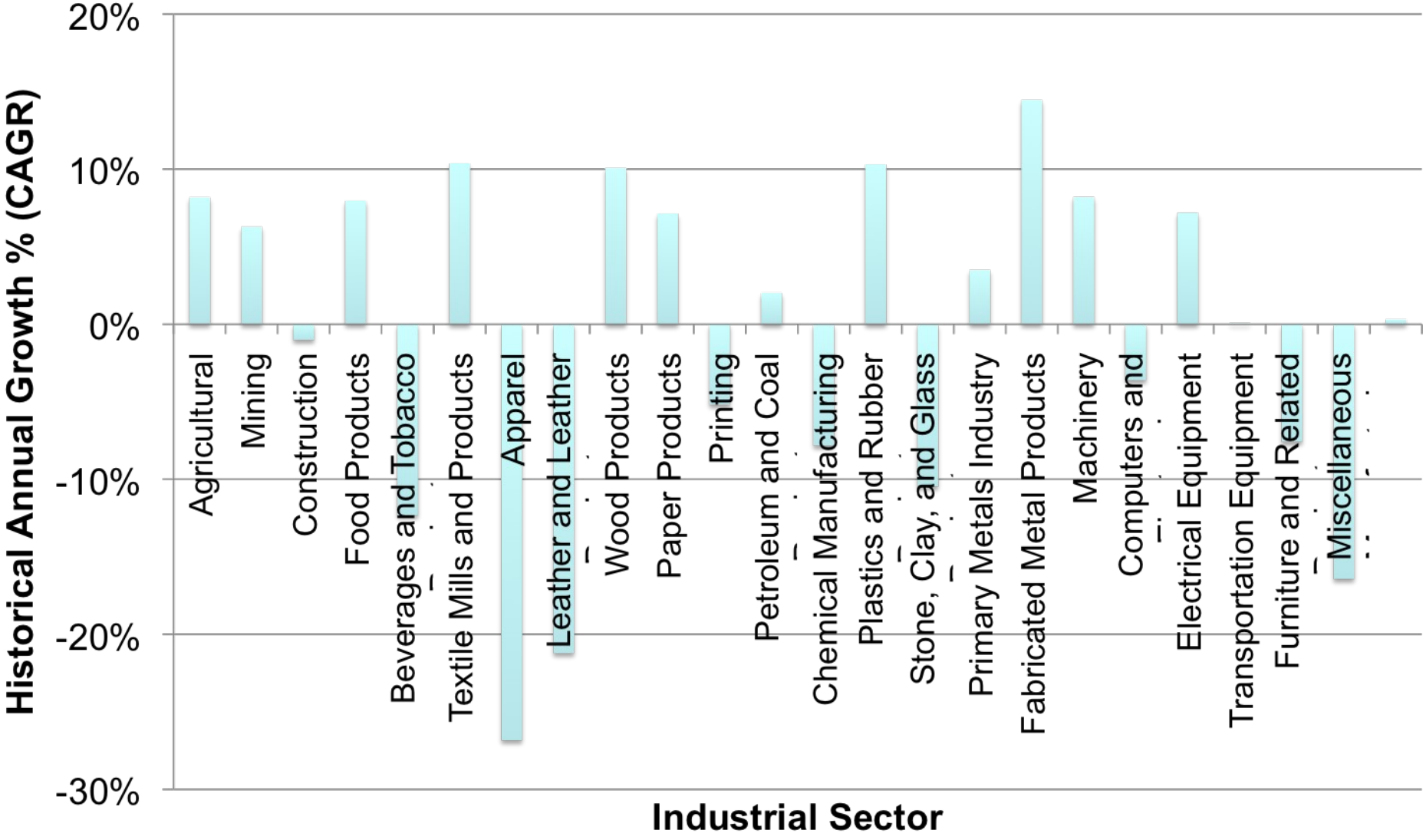
Appendix: Efficiency Measures for Existing Residential

Measure	Description
CFLs	Replace 100W incandescents with 23 W CFLs
New refrigerator	Replace existing fridge with new unit
DHW improvements	Tank blanket, pipe insulation, lower set point
Replace HVAC (cooling)	Upgrade central unit EER from 10 to 16.8
Replace window/wall AC	Upgrade EER from 8.85 to 12
Replace HVAC (heating)*	Install heat pump (COP = 3.15) instead of electric resistance heating (COP = 1)
Real-time energy monitoring	Install device displaying real-time energy use
Efficient plug loads	Replace appliances with most efficient options
Reflective roof coating	Apply coating in hot climates when reroofing
Weatherization	Various measures to reduce infiltration
Programmable Thermostats	Expanded heating/cooling setpoints during unoccupied periods
Smart power strips	Reduce standby power losses in plug loads

Appendix: Efficiency Measures for Existing Commercial

Measure	Description
Lighting	Replace T12s with third generation T8s
Efficient Fans	Replace fans with efficient, variable speed fans
Efficient pumps	Replace pumps with efficient, variable speed pumps
Upgrade cooling system	Upgrade to most efficient commercial cooling system (air cooled DX or central chilled water)
Retro-commissioning	Improve overall building operations
Efficient office & cooking equipment	Offices: Replace monitors, hard drives, printers, copiers, etc. Restaurants: Upgrade refrigeration and cooking equipment
Improved HVAC controls	Still in progress
Smart power strips	Reduce standby losses
Repaired duct leakage	Seal air leakage in existing ductwork
Maintenance	Implement regular HVAC and lighting maintenance programs
Improved refrigeration	Applicable to supermarkets and food service

Appendix: Change in Consumption for US Industrial Sectors (2002-2007)



Appendix: Industrial Savings by Measure

Measure	GWh Savings (2030)
Advanced forming/near net shape technology	75
Advanced Curing Technologies	1,510
liquid mebrane technologies-chemicals	3,622
gas membrane technologies-chemicals	70
Advanced lubricants	3,430
E-beam sterilization	160
membrane technology wastewater	0
Efficient refrigeration systems	887
Compressed air system management	10,811
Motor system optimization	2,871
electric supply system improvements	26,443
Sensors and controls	2,800

Measure	GWh Savings (2030)
Air Compressor Systems Advanced Controls	512
motor management	4,130
Pump efficiency improvement	22,866
Efficient lighting design -- Office	4,462
Efficient lighting design -- Manuf	10,884
Efficient lighting design -- Warehouse	8,720
Advanced motor designs	23,175
Fan system efficiency	3,774
Recomissioning	45,482
Efficient cell retrofit designs	407
Duct/Pipe Insulation	26,596
Energy Information Systems	19,516

List of Cost-effective measures only

Appendix: Sources

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Appendix: Sources

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3. EIA. Annual Energy Outlook 2007, 2009.
4. ACEEE end-use breakdown data found in Table 5.3.3.01 of NYSERDA (2003). "Energy Efficiency and Renewable Energy Resource Development in New York State."
5. ACEEE measure data sent through correspondence with Skip Laitner and Dan Trombley, ACEEE. Measure list employed in ACEEE (2009). Potential for Energy Efficiency, Demand Response and Onsite Solar Energy in Pennsylvania. Washington, DC.