RAP Energy solutions for a changing world

Module 2
Characterizing Energy Efficiency and Its Benefits

Electric Energy Training for Air Regulatory & Planning Staff
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Module Two: 1030-1145 AM

- Characterizing Energy Efficiency and Its Benefits

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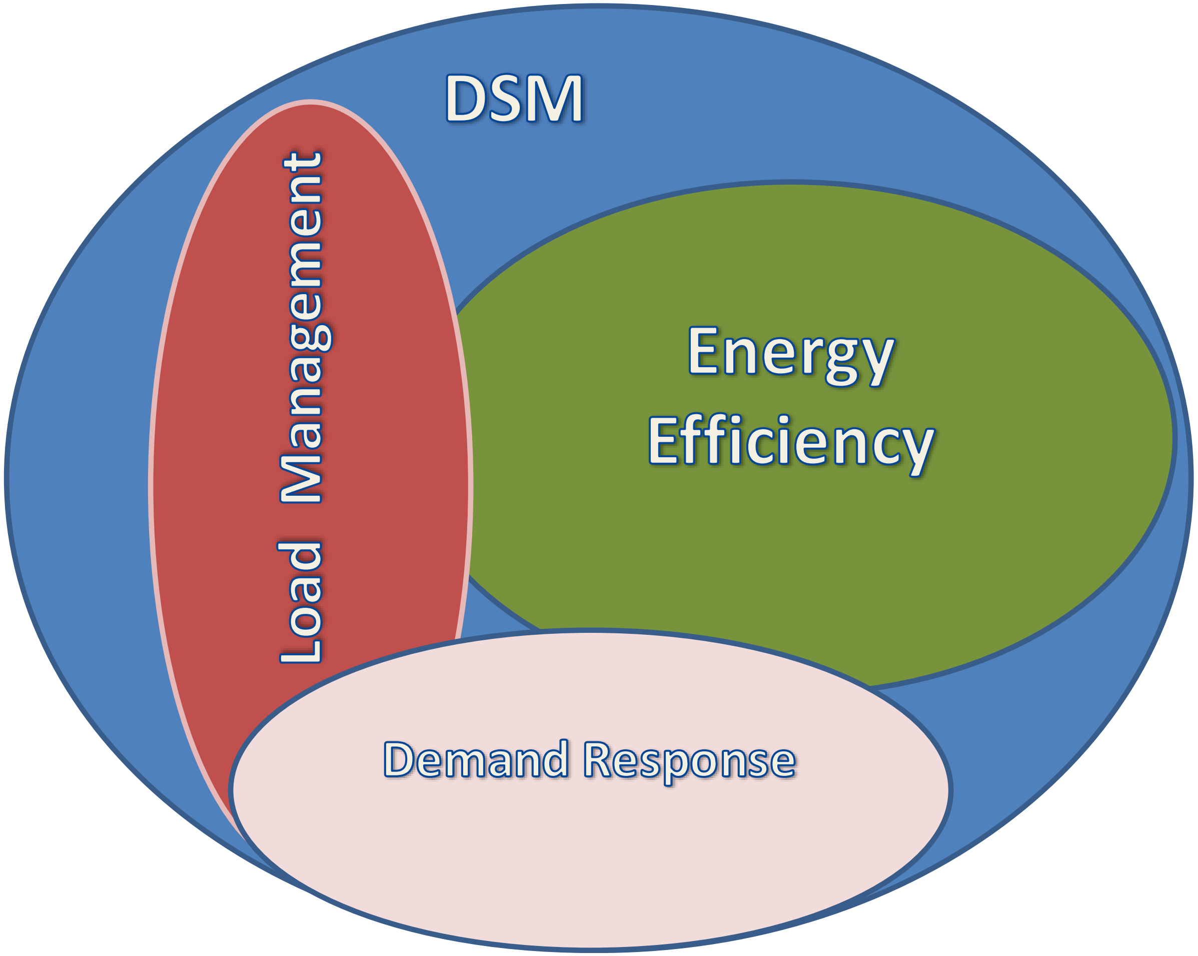
Objectives of Energy Efficiency (EE) Module

- Definition of EE
- Examples of EE policies and measures
- Differences between EE and RE
- Development of EE policies
- EE policies implemented at local, state and federal level
- EE Benefits
  - Energy, economic, environmental
  - How to determine
  - Scale of results, limits to implementation
- Demand response

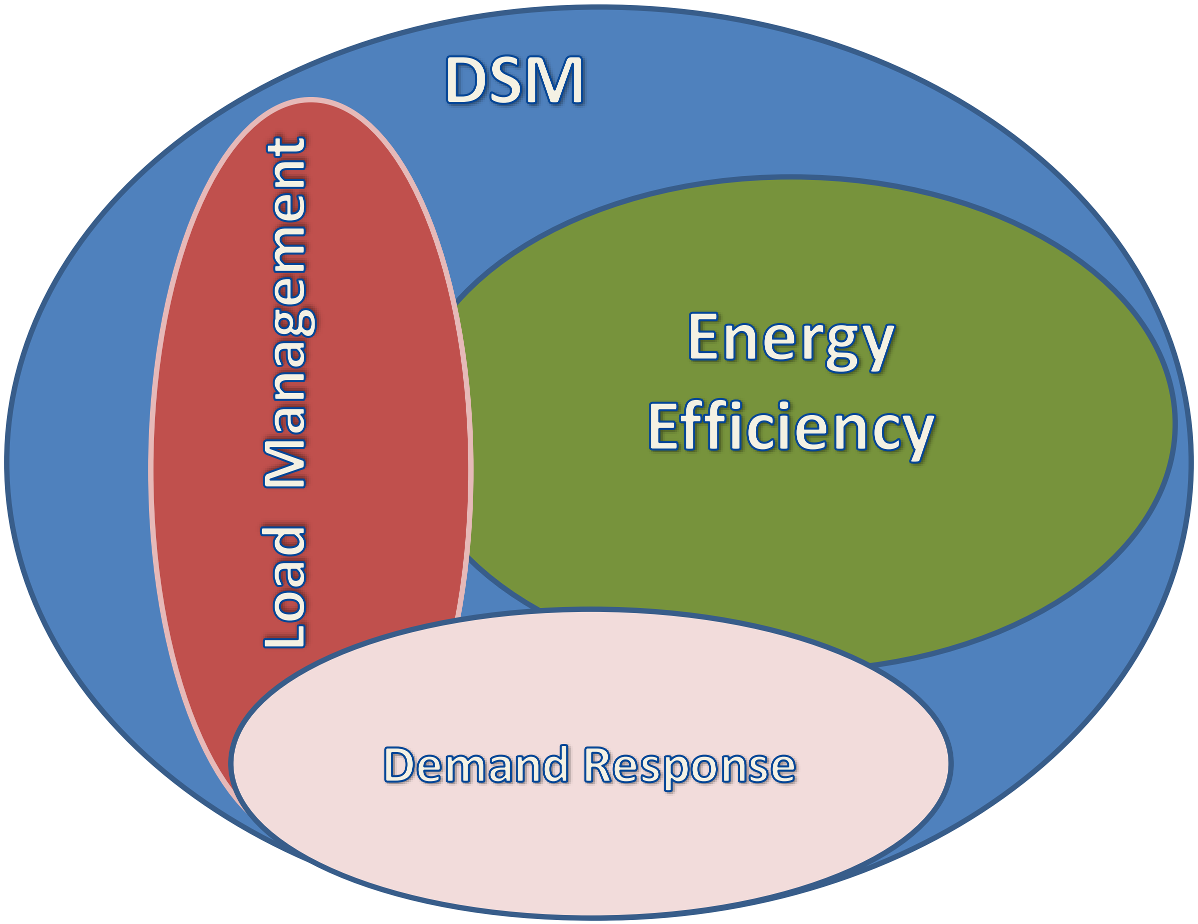
Energy Efficiency is One Part of Demand Side Management



DSM: Demand-side Management

- DSM comprises actions taken on the customer's side of the meter to change the quantity and/or timing of the energy used by the customer in ways that will provide benefits to the energy supply system
- DSM strategies aim to avoid or postpone the construction of new electricity generating plant and/or the expansion or augmentation of the electricity grid
- DSM is an alternative to solutions that focus on the supply side
- DSM includes both end-use energy efficiency and load management

Energy Efficiency



Energy Efficiency (1)

- Energy efficiency refers to efforts to provide the <u>same level of energy service or performance</u>, such as heating or cooling a building or motorization, <u>with less energy input</u>
- Example: an energy efficiency program may aim at replacing a standard electric motor with a high-efficiency motor; this gets the same work done using less electricity
- Energy efficiency directly results in reduced emissions and reduced carbon intensity

Energy Efficiency (2)

- Characteristics of EE:
  - Dispersed, decentralized installations
  - Benefits measured through algorithms based on audited energy savings
  - Energy saved or avoided is not yet tracked by regional transmission operators

Load Management

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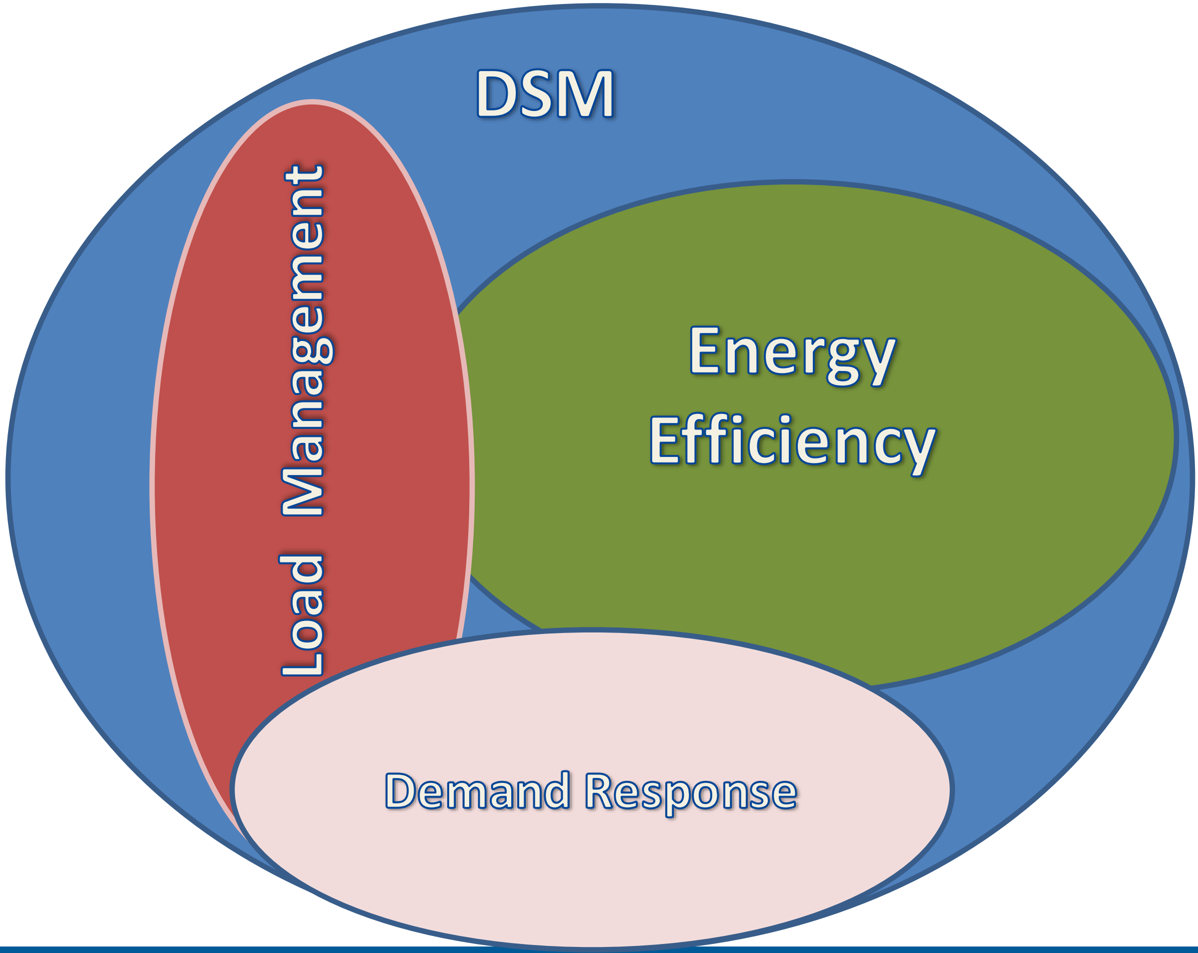
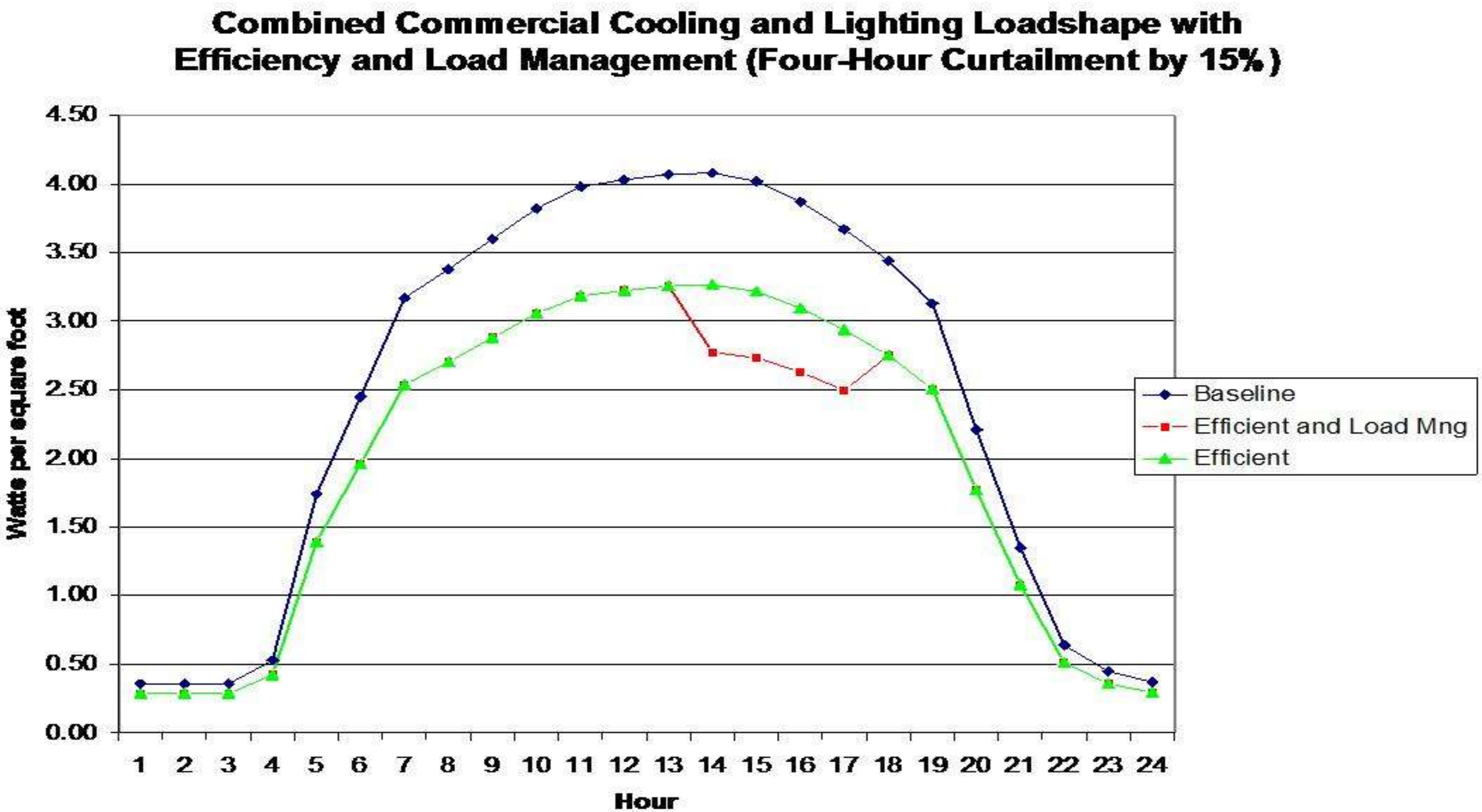


Load Management (1)

- Load management refers to efforts to reduce peak demand or shift demand from on-peak to off-peak periods
- Example: Shifting production so that a motor is used during off-peak periods instead of on-peak
- Load management may or may not improve end-use energy efficiency or reduce emissions, depending on the mix of generation available and system dispatch rules
- Load management usually results in lower transmission and distribution system losses

Load Management (2)



EE vs. RE: Similarities

- EE resources can be sized and deployed to meet customer requirements (variable size, dispersed or concentrated)
- Reduce the need to operate marginal or peaking generation, especially on high electric demand days (HEDD), reducing emissions and electricity prices

EE vs. RE: differences

- **Renewable Energy**
  - RE output can be directly measured
  - Like any power plant, 100% of RE project must be complete before 1 MWh of output occurs
  - RE output can be transmitted across long distances
  - RE can be installed at or near same locations as retired or mothballed power plants

- **Energy Efficiency**
  - EE benefits require auditing and statistical sampling to first determine energy savings
  - EE benefits begin as soon as the first measure is installed
  - EE can defer or avoid the need to upgrade or construct new transmission
  - EE energy savings are cumulative. Assuming the program continues, savings accrue each year.

Energy Efficiency Planning Definitions

- **Measure:** A specific element (e.g. residential lighting)
- **Program:** A group of measures (low-income program, new commercial building program)
- **Project**: Several measures installed concurrently at same location (e.g.. whole building concept)
- **Portfolio**: The entire group of measures and programs
- **Goal**: Maximize benefits, "touch" customer only once (if possible)

Air and Energy Nomenclature: Developing Bilingual and Multilingual Skills

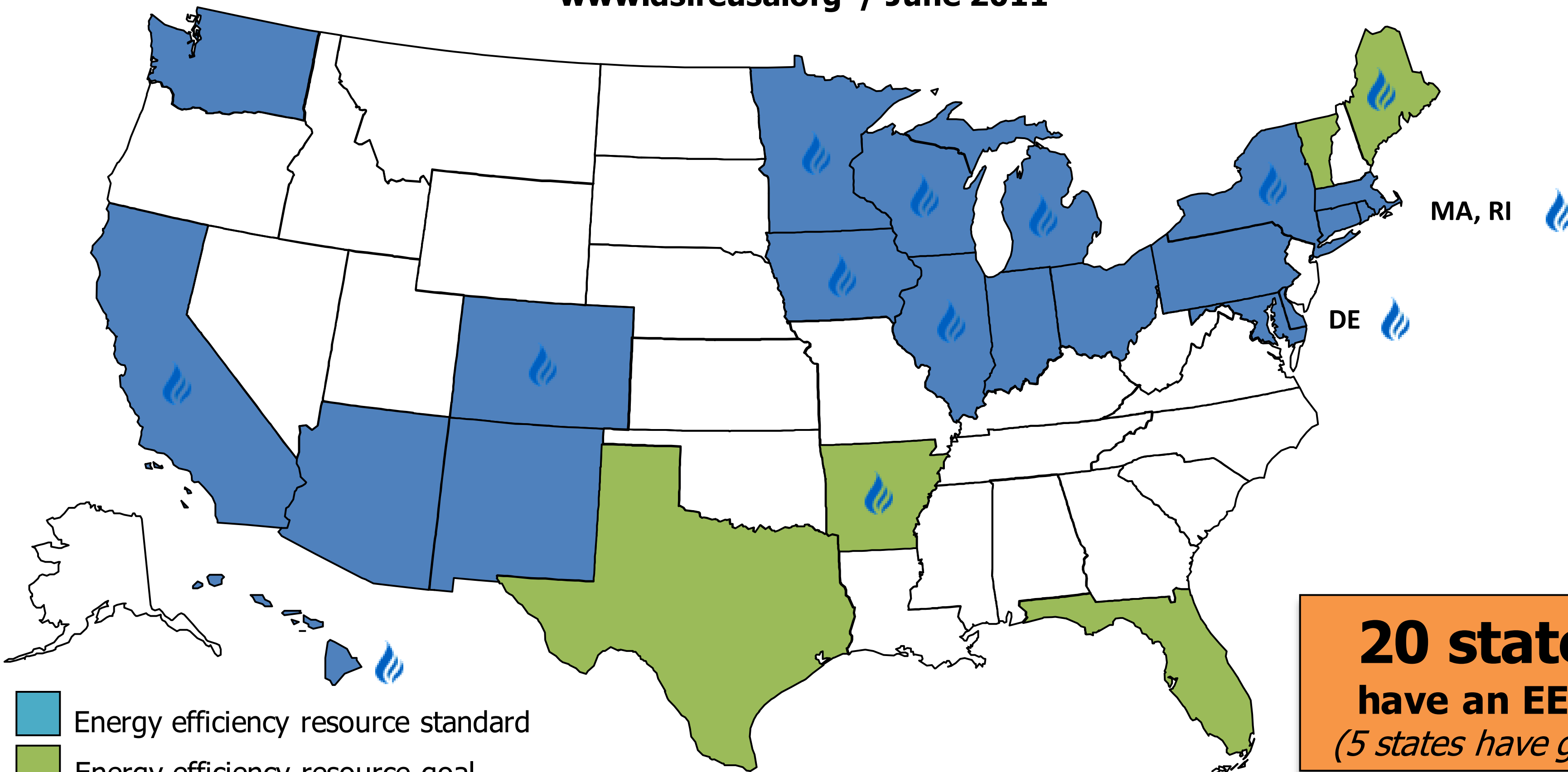
- An energy efficiency program can be an air quality measure
  - EE programs are directed, reviewed, approved by public service commissions. Energy offices and 3rd parties coordinate planning, implement programs
- Measure, policy, program have different meanings to energy regulators
  - Need to remember to whom you are speaking, and terms of art have different meanings, even though the letters or words may be the same
- An air quality measure can be:
  - Narrow (i.e. LED traffic light changeout)
  - Broad (i.e. a state portfolio of EE resources that cleared the New England regional capacity market)
- And, terminology can vary by region and state

Examples of EE Policies

- Energy efficiency resource standard (EERS)
  - Requires specific quantity of EE resources to be procured each year
- Output-based emissions standard
  - Lbs-pollutant-per-MWh encourages efficient fuel consumption
- Whole house concept or integrated systems thinking
  - Apply all measures to a home or building, including boiler and A/C
- Fuel-neutral or all-fuels
  - Address electric, gas and oil consumption at the building at same time (vs. gas only or electric only)

Energy Efficiency Resource Standards

www.dsireusa.org / June 2011



20 states
have an EERS
(5 states have goals)

- Energy efficiency resource standard
- Energy efficiency resource goal
- Policy includes natural gas savings requirements or goals

Note: See following slide for a brief summary of policy details. For more details on EERS policies, see www.dsireusa.org and www.aceee.org/topics/eers.

EERS Policy Details

AZ: 22% cumulative electricity savings by 2020

AR: 0.75% of 2010 electric sales reduction by 2013; 0.4% of 2010 gas sales reduction by 2013

CA: Varies by utility

CO: Electricity sales and demand reduction of 5% of 2006 numbers by 2018 (statutory requirement); natural gas savings requirements vary by utility

CT: 4% of retail load (includes CHP and waste heat recovery)

DE: Electricity and peak demand savings equivalent to 15% of 2007 numbers by 2015; natural gas savings equivalent to 10% of 2007 natural gas consumption by 2015

FL: 7,842 GWh cumulative reductions from 2010-2019 (statewide goal); 3,024 MW cumulative summer peak demand reduction from 2010-2019, 1,937 MW, cumulative winter peak demand reduction from 2010-2019 (statewide goal)

HI: 4,300 GWh reduction in electricity use by 2030

IL: 2.0% reduction of 2008 electricity sales by 2015; 1.1% reduction of 2008 peak load demand by 2018; 8.6% cumulative natural gas savings by 2020

IN: 2.0% electricity sales reduction by 2019

IA: 1.5% electricity sales reduction by 2013; 1.5% natural gas sales reduction by 2013

ME: 30% reduction of electricity and natural gas sales by 2020

MD: 15% reduction in per capita energy consumption by 2015, compared to 2007; 15% reduction in per capital peak demand by 2015, compared to 2007

MA: Reduce 1,103 GWh electricity in 2012 (statewide); reduce 24.7 million therms by 2012 (statewide)

MI: 1.0% annual reduction of previous year retail electricity sales by 2012; 0.75% annual reduction of previous year retail natural gas sales by 2012

MN: 1.5% reduction of previous 3-year average retail electric sales by 2010; 1.5% reduction of previous 3-year average retail natural gas sales by 2010

NM: 10% of 2005 total retail kWh sales by 2020

NY: 15% reduction relative to projected electricity use in 2015; gas savings of 112 Bcf annually by 2020

OH: 22.0% reduction of previous 3-year average retail electricity sales by 2025; 7.0% reduction of previous 3-year average peak demand by 2017

PA: 3% of projected June 2009 - May 2010 electricity consumption by May 31, 2013; 4.5% of measured June 2007 - May 2008 peak demand by May 31, 2013

RI: Varies by utility

TX: 25% reduction in annual growth in demand 2012; 30% reduction in annual growth in demand 2013

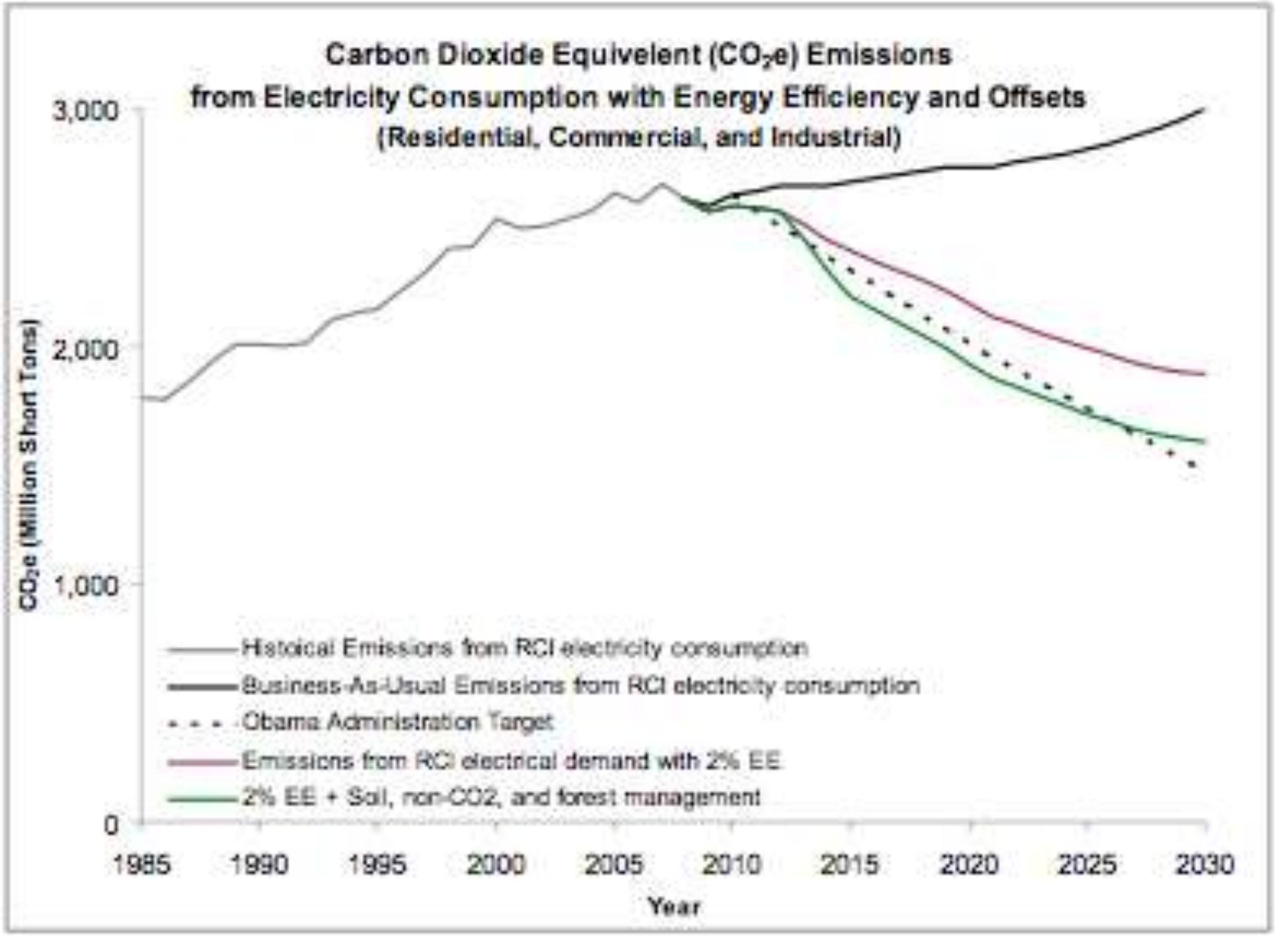
VT: 360,000 MWh electricity savings (3-year goal for 2009, 2010, 2011); summer peak kW savings: 51,200 (3-year goal for 2009, 2010, 2011), winter peak kW savings: 54,000 (3-year goal for 2009, 2010, 2011)

WA: Varies by utility

WI: 1.5% electricity savings by 2014; 1.5% peak demand reduction by 2014; 1.0% natural gas savings by 2014

Note: For more details on EERS policies, see www.dsireusa.org and www.aceee.org/topics/eers.

National Potential of EE Programs to Reduce Emissions



Who Develops, Implements and Enforces EE Policies?

- Federal:
  - Appliance standards (DOE)
- State:
  - Ability to pass more stringent energy standards than federal (i.e., like the California car under the CAAA mobile source program)
  - Require utility or state-level DSM programs
  - Create, establish and update building codes and standards
- Local:
  - Enforce state building codes and standards
  - Zoning requirements (i.e., Austin, TX ordinance on home size)
  - Ability to adopt more stringent codes and standards than state
- Local policies may not be included in EIA forecast; air quality planners will need to account for them

Energy Efficiency Provides Energy, Economic and Environmental Benefits

- Directly and indirectly reduces customer bills
- Reduces risk of fuel price volatility from fossil fuel
- Improves energy security
- Provides capacity to improve reliability of electricity system
- Reduces stress on transmission and distribution system
- Accumulates benefits over life of measure, project, program and portfolio
- Reduces criteria, toxic and greenhouse gas emissions
- Improves land and water quality

Estimating the Benefits of EE

- Evaluation Measurement and Verification (EM&V)
- Must satisfy same enforceability criteria as other air quality control measures, i.e., RSVP&E
- Definitions, concepts and roles
  - DEP, PUC, EPA regions
- Tools and techniques for future forecasting
- EM&V to be covered in more detail in Module 4

Recognizing the Benefits of EE

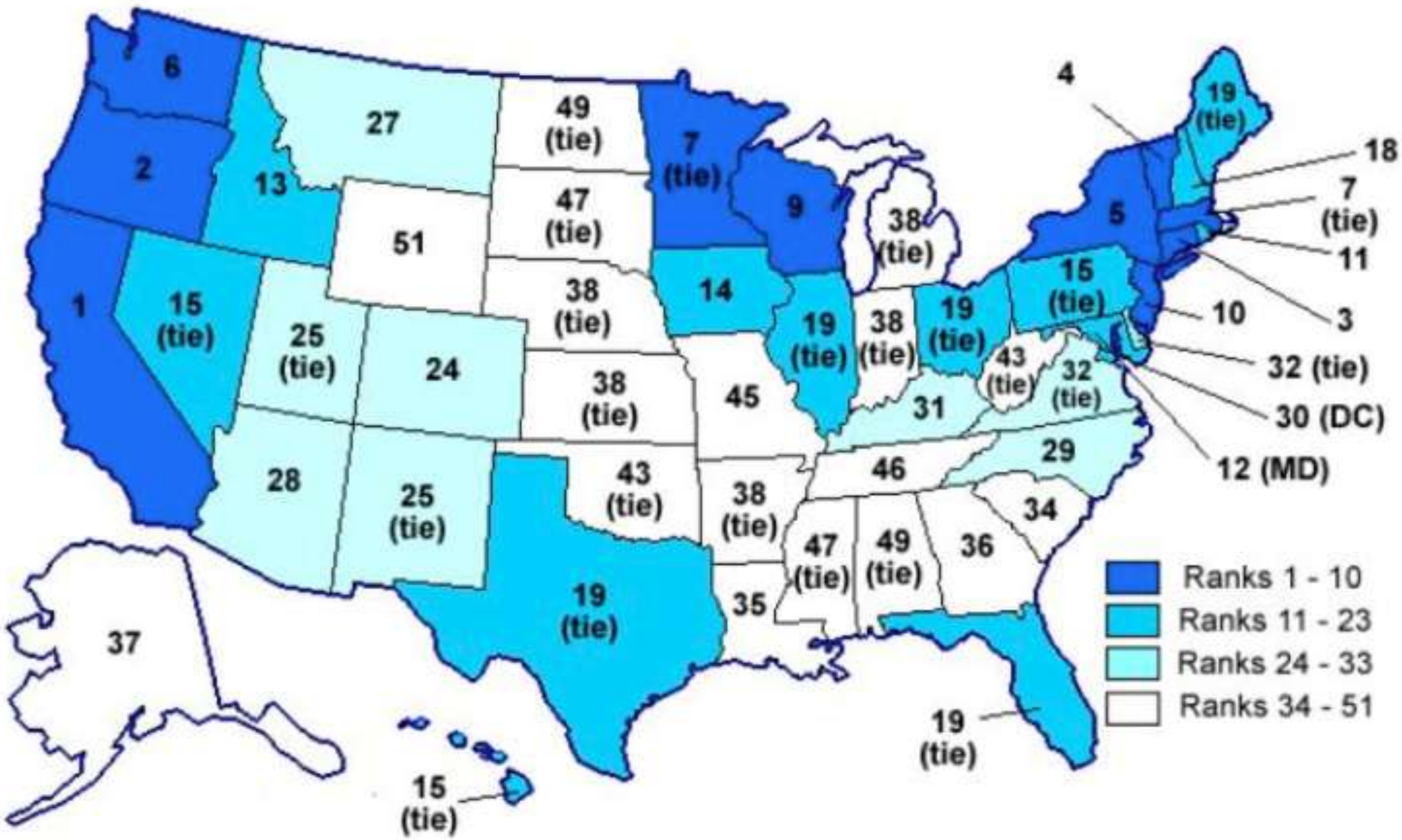
- Scale of results to date and impact
- Progress by EPA; what remains to be done
- Economic and system benefits

Annual U.S. Electricity Growth Rate

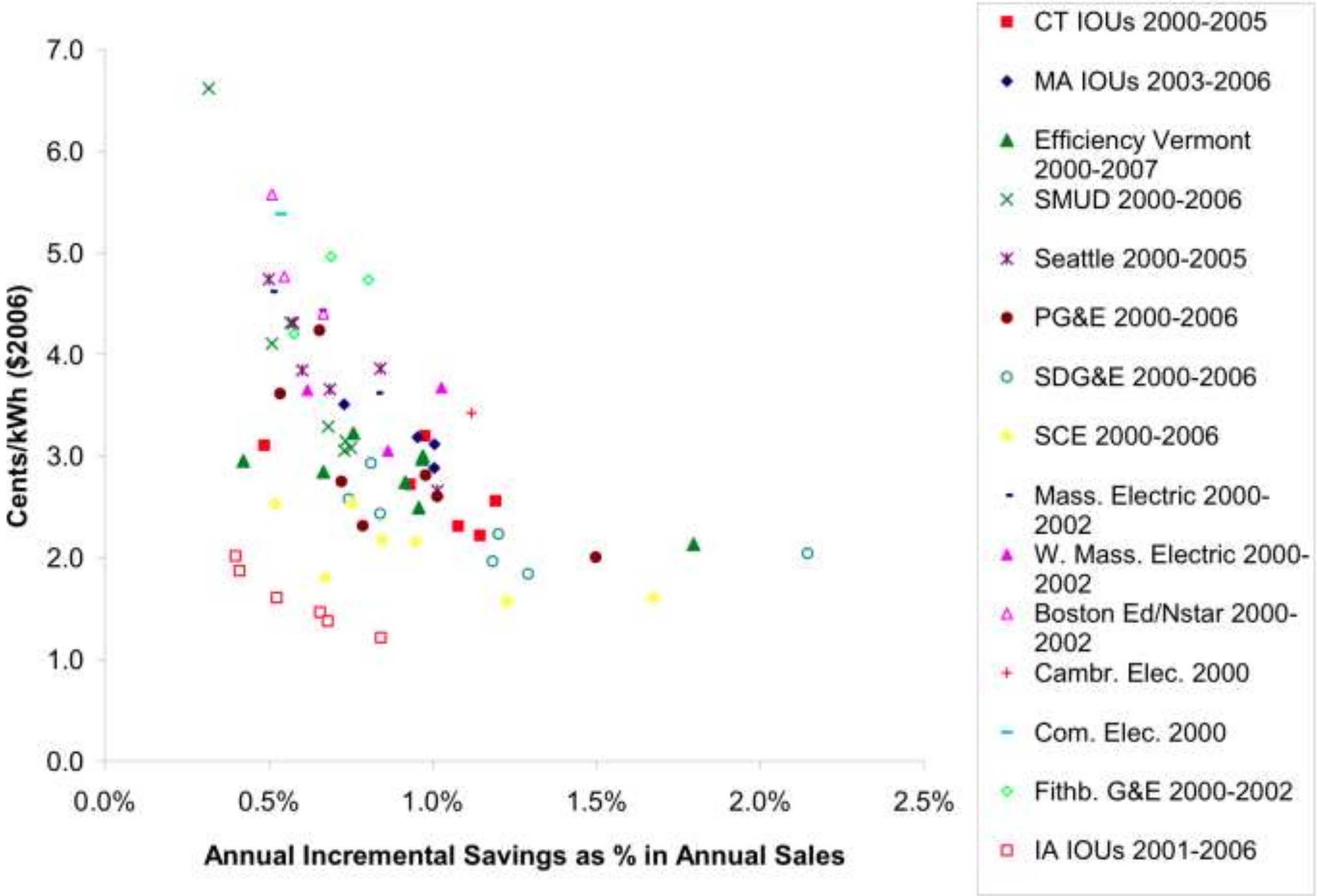
Figure 7-9. Electricity Growth Rate (3 Year Rolling Average) and Projections from the Annual Energy Outlook 2011

Source: EIA Annual Energy Review 2009 and Annual Energy Outlook 2011

How Are US States Performing?
(State Rankings by ACEEE)



Energy Saved by EE and Its Cost



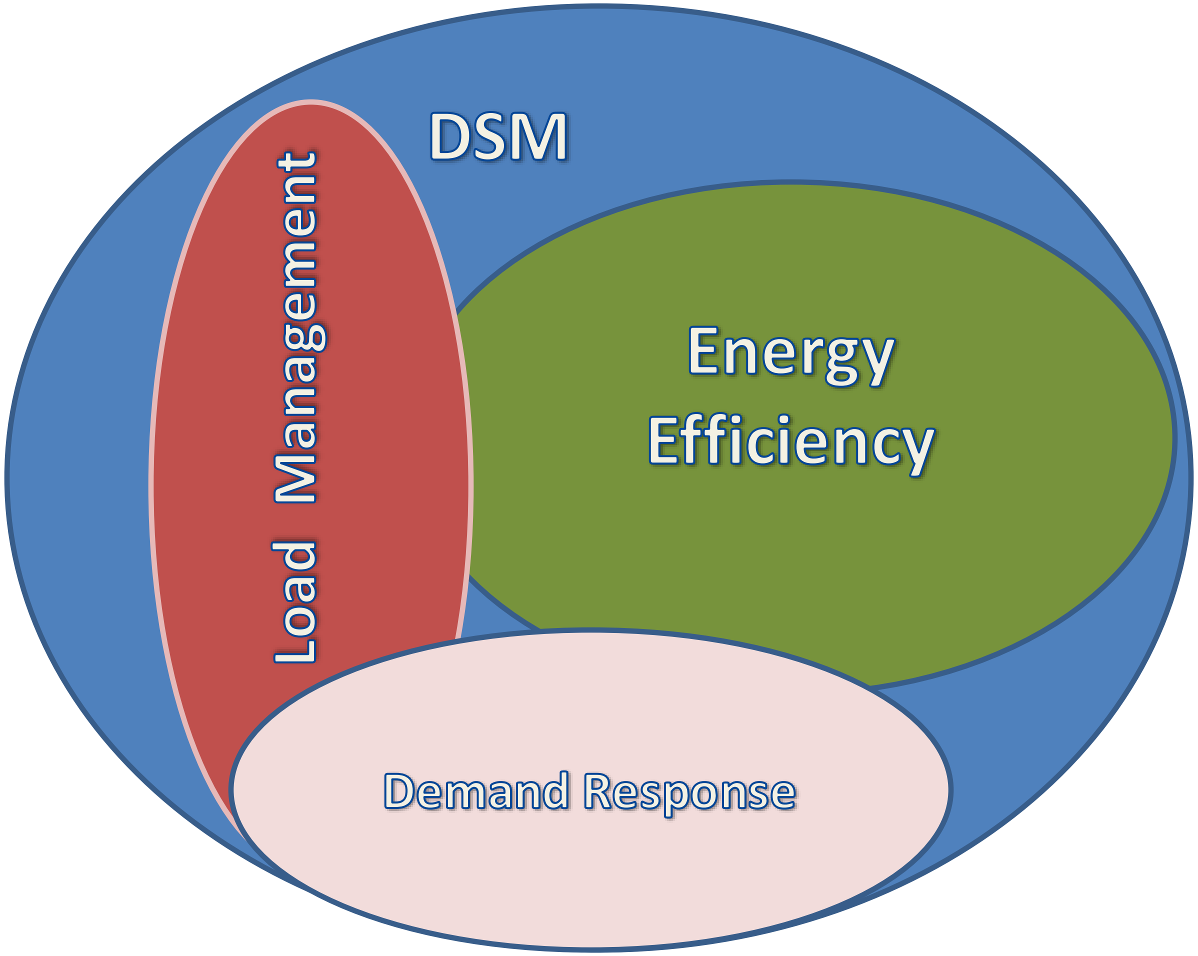
EE Results to Date and Impact

- DOE EIA forecasts 2010-2035 USA load growth to be 1% annually
- State programs have equaled/exceeded this level in: CA, CT, MA, IA, VT, WI; are forecast to do so in: IL, OR, WA
- EE is reducing cost to maintain reliable electricity grid in New England and PJM:
  - Combination of increased demand resources, stable natural gas prices have idled several older power plants, led to planned closure of some units
  - Salem Harbor RMR decision by FERC requires transmission operators to complete studies to show the affect of alternative resources (like DSM) on reliability

Barriers: Why Hasn't EE Been Included in Air Plans?

- Emissions benefits determined indirectly vs. directly (e.g., by CEMS)
- Tens of thousands of discrete measures vs. a few dozen EGU
- Degree of benefit varies by state, region
- High transaction costs, or perception thereof, from previous EPA guidance
- Tendency to focus on specific measures vs. program or portfolio

Demand Response



Demand Response (1)

- Similar to load management
- Refers to customers changing their normal consumption patterns in response to changes in the price of energy over time or to incentive payments designed to induce lower electricity use when prices are high or system reliability is in jeopardy
- Demand response practices often give consumers real-time price signals to encourage them to adjust their electricity use to changing conditions in the power grid
- Demand response also includes automated efforts to link customer use to grid costs and conditions

Demand Response (2)

- DR programs are typically designed by utilities and transmission operators
- In the past, main DR participants were large commercial/industrial customers and government
- Customers are paid to turn off their load within 15-30 minutes of being notified by DR program operator
  - Day-ahead notice is usually provided to DR customers

Demand Response (3)

- DR can mean turning load off (passive) or shifting load to a back-up generator (active)
- DR customers are paid to provide capacity and paid when they participate in the DR program
- DR programs save customers and utilities money by avoiding the need to purchase expensive electricity at peak time periods
  - Emissions are also typically reduced

Demand Response (4)

- DR programs can reduce emissions at peak, especially when the peak electricity demand coincides with periods of peak pollutant concentrations
- Specific air quality benefits depend upon the design of the DR program and what DR resources are called upon to participate
  - A DR program that results in turning on back-up diesel generators may increase emissions
  - DR programs that result in load being turned off or shifted can decrease emissions
- Increased penetration of smart meters may permit residential customers to participate in DR programs and receive payment for doing so.
- Some utilities have adopted time of use rates to discourage consumption during peak time periods through higher rates per kWh of electricity consumed

Question and Answer Period

- What could EPA do to remove barriers/increase penetration of EE/DR ?
- Thank you!