USEA GLOBAL WORKSHOP ON LOW CARBON POWER SECTOR DEVELOPMENT

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Overview of Demand Resources in New England

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ISO new england

Disclaimer

- All views and opinions expressed in this presentation are strictly those of the presenter and do not necessarily reflect the views of ISO New England.

Special Appreciation

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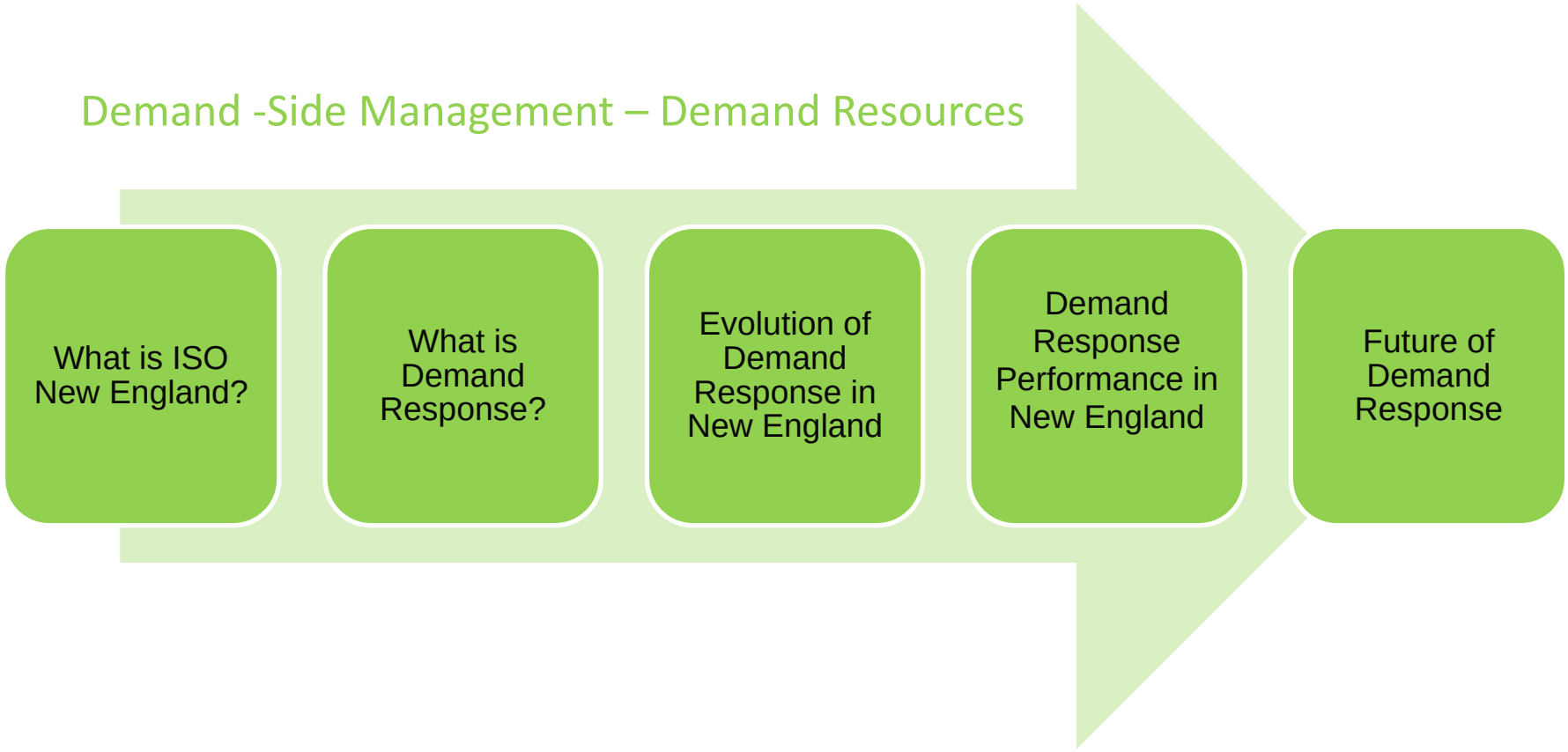
Topics



ISO New England Overview

A Little Bit of Regional History

- After the 1965 Northeast blackout, there was a need seen for regional effort to manage daily electricity load and ensure stable supply
- 1971, New England Power Pool (NEPOOL) created:
  - Integrated utilities and municipal systems
  - Established central dispatch system
  - Enhanced New England system's reliability
- 1996, FERC Order 888
  - Deregulated portions of the market
  - Change in NEPOOL role
  - ISO New England created (established in 1997)

About ISO New England

- **Not-for-profit corporation created in 1997 to oversee New England's restructured electric power system**
  - Independent of companies doing business in the market
  - Regulated by the Federal Energy Regulatory Commission (FERC)

- **470 Employees**
  - Headquartered in Holyoke, MA
  - Largely power system engineers, economists and computer scientists

ISO New England's Major Responsibilities

Operating the Power System

- Balance electricity supply and demand every minute of the day by centrally dispatching the generation and flow of electricity across the region's transmission lines

Power System Planning

- Ensure the development of a reliable and efficient power system to meet current and future electricity needs

Oversee Wholesale Electricity Markets

- Develop and administer the region's marketplace through which wholesale electricity is bought and sold

ISO New England's Responsibilities Are Defined and Guided by Rules and Standards

FERC
FEDERAL ENERGY REGULATORY COMMISSION

Defines ISO's authority and the services it provides. ISO responsibilities are guided by rules approved or mandated by FERC.

NERC coordinates its activities with eight regional entities. NPCC develops, implements, and enforces criteria for the design and operation of the interconnected power systems in the Northeast.

Rules and standards give industry certainty of purpose and provide clear goals for maintaining reliable electricity service at competitive prices.

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

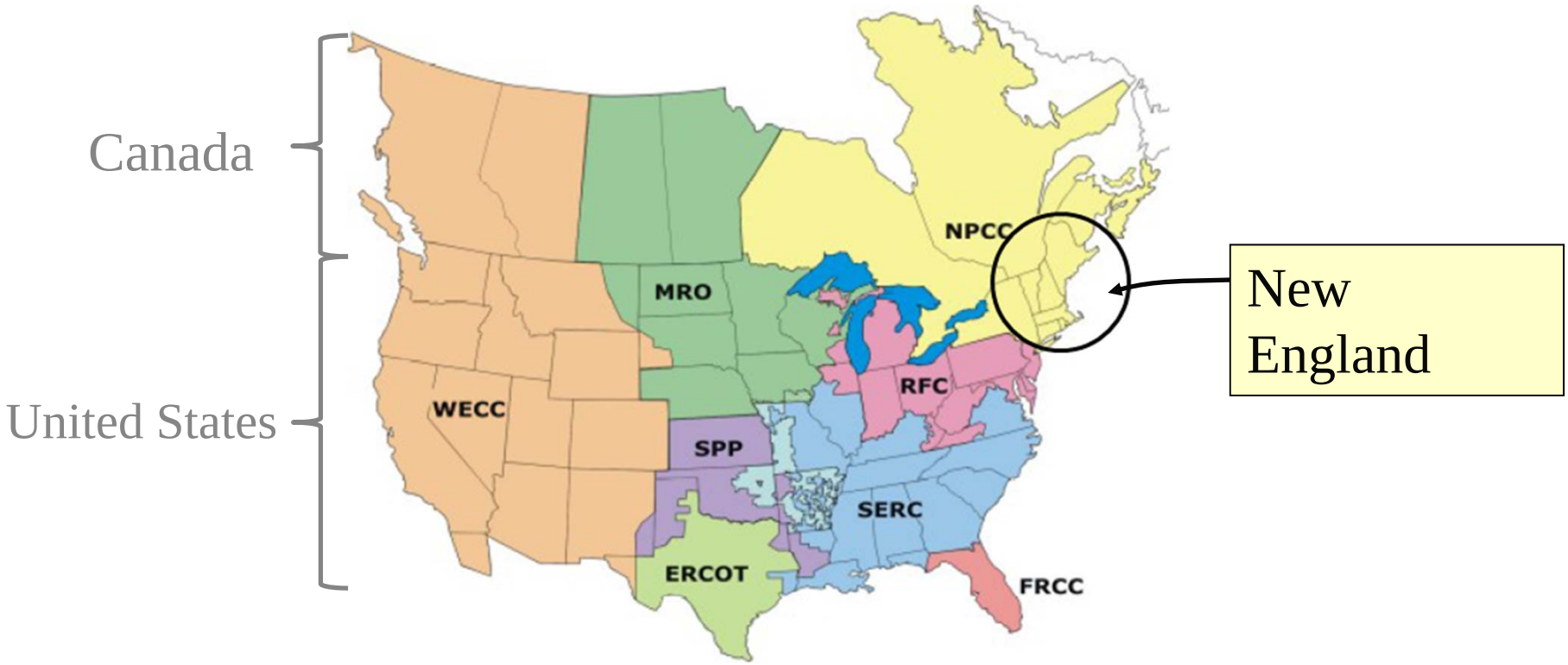
Develops and ensures compliance with mandatory standards for planning and operating power systems in North America. Can levy fines of $1,000 to $1 million per day for violations.

Develops and follows procedures to meet the numerous, stringent reliability standards.

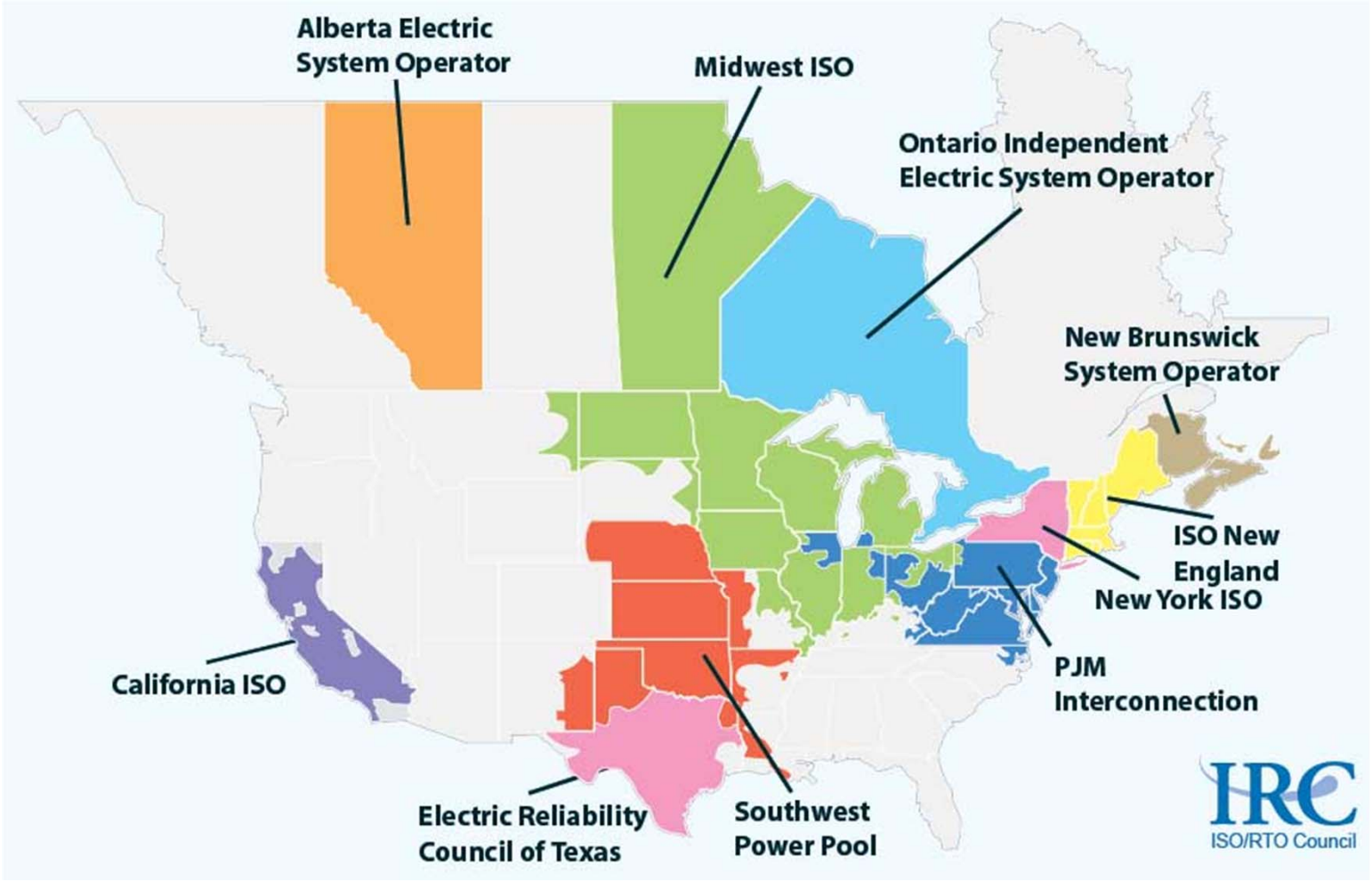
ISO new england

New England is in the North East

- New England is in the North Eastern United States
- Part of Northeast Power Coordinating Council (NPCC)
- NPCC is one of eight NERC Reliability Regions



Existing ISO/RTO Configurations



Source: ISO/RTO Council

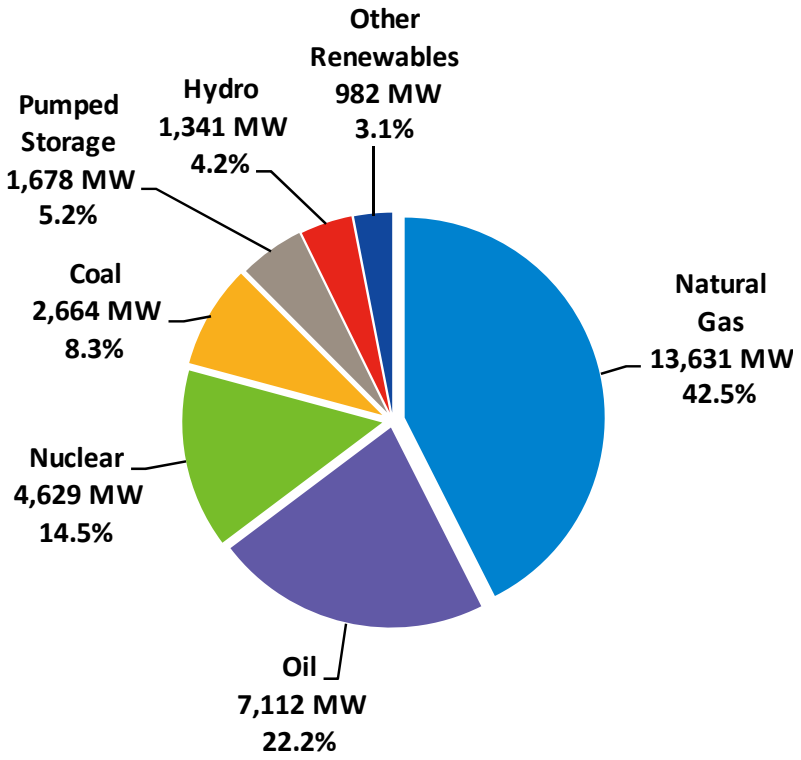
New England's Electric Power Grid

A tightly integrated regional power system

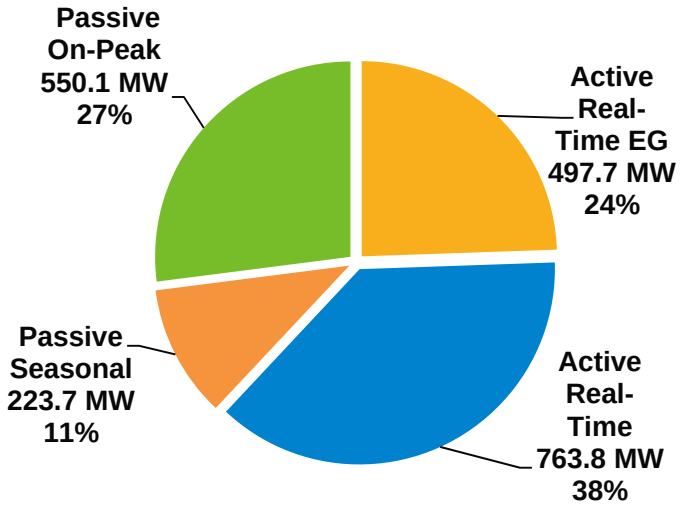
- 6.5 million households and businesses; population 14 million
- More than 300 generators
- Over 8,000 miles of high-voltage transmission lines
- 13 interconnections to electricity systems in New York and Canada
- Approx. 32,000 megawatts of total supply and 2,035 megawatts of demand resources
- All-time peak demand of 28,130 megawatts, set on August 2, 2006
- More than 450 participants in the marketplace
- $5-11 billion annual energy market value

ISO New England Control Room

2011 Summer: Installed Generation and Demand Resources Capacity



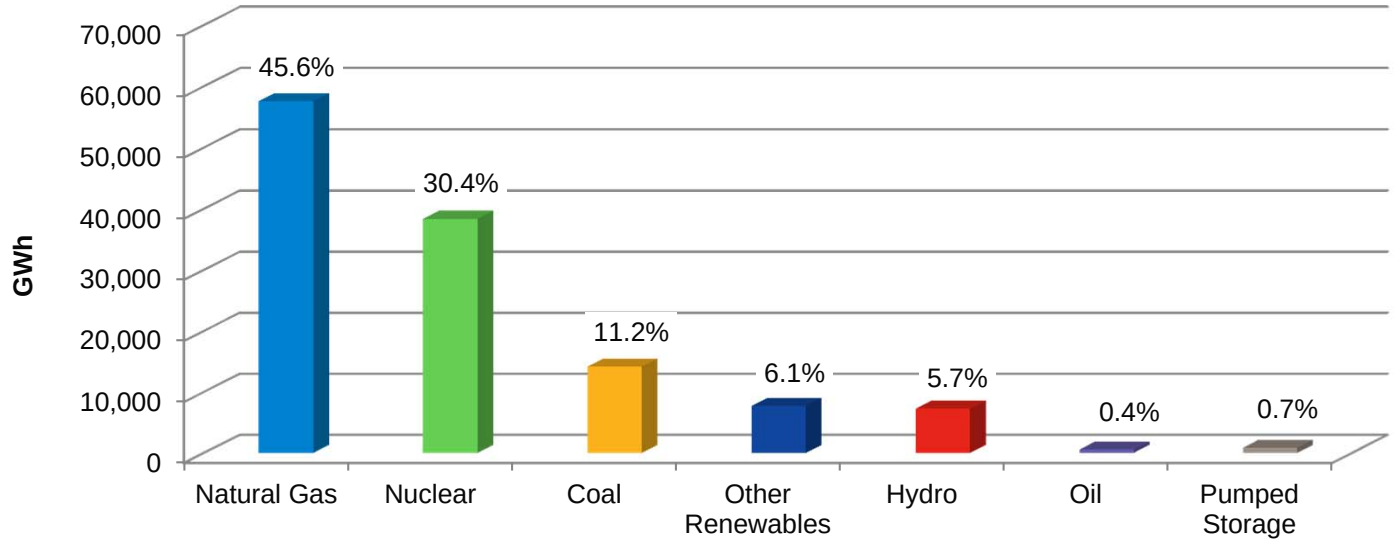
Generation Total = 32,037 MW



Demand Resources Total = 2,035 MW

- Values do not include external resources, such as purchases, and sales.
- The "Other Renewables" category includes landfill gas, other biomass gas, refuse (municipal solid waste), wood and wood-waste solids, wind, and tire-derived fuels.
- Demand Resources values are based on 2011 Summer Capacity Supply Obligations from the 2011 CELT

2010 Generator Energy Production by Fuel Type



- The “Other Renewables” category includes landfill gas, other biomass gas, refuse (municipal solid waste), wood and wood-waste solids, wind, and tire-derived fuels.

What is Demand Response?

What is Demand Response?

- Customers reducing their electricity consumption in response to either:
  - high wholesale prices
  - system reliability events
  - firm service obligations
- Customers being **paid** for performance based on wholesale market prices

Key Definitions

Term	Definition
Demand Resource/ Asset	• A Load or aggregation of Loads capable of measurably and verifiably providing Demand Response. - Demand Asset is level where load is measured. - Demand Resources in New England are groups of Demand Assets.
Demand Response	A temporary change in electricity consumption by a Demand Resource in response to market or reliability conditions. For purposes of these standards, Demand Response does not include energy efficiency or permanent Load reduction.
Baseline	• A Baseline is a method of estimating the electricity that would have been consumed by a Demand Resource in the absence of a Demand Response Event. • The Baseline is compared to the actual metered electricity consumption during the Demand Response Event to determine the Demand Reduction Value. Depending on the type of Demand Response product or service, Baseline calculations may be performed in real-time or after-the-fact.

Demand Response Products

Term	Definition
Energy Service	A type of Demand Response service in which Demand Resources are compensated based solely on Demand reduction performance.
Capacity Service	A type of Demand Response service in which Demand Resources are obligated over a defined period of time to be available to provide Demand Response upon deployment by the System Operator.
Reserve Service	A type of Demand Response service in which Demand Resources are obligated to be available to provide Demand reduction upon deployment by the System Operator, based on reserve capacity requirements that are established to meet applicable reliability standards.
Regulation Service	A type of Demand Response service in which a Demand Resource increases and decreases Load in response to real-time signals from the System Operator. Demand Resources providing Regulation Service are subject to dispatch continuously during a commitment period. Provision of Regulation Service does not correlate to Demand Response Event timelines, deadlines and durations.

*Definitions from North American Energy Standards Board

Resources in New England Markets

- Supply Resources
  - Traditional Generation (oil, coal, natural gas, etc.)
  - Intermittent Generation (wind, solar, etc.)
  - Imports

- Demand Resources
  - Energy Efficiency
  - Load Management
  - Distributed Generation

- Minimum project size = 100kW

Demand Resource Categories

- Passive Demand Resources (passive DR)
  - On-Peak & Seasonal Peak
  - Defined at a Load Zone
  - Reduce energy demand (MW) during peak hours
  - Are *non*-dispatchable

- Active Demand Resources (active DR)
  - Real-Time Demand Response & Real-Time Emergency Generation
  - Defined at a Dispatch Zone
  - Reduce energy demand (MW) during reliability hours
  - Operate based on real-time system conditions via dispatch by ISO (dispatchable)

On-Peak Demand Resources

- Designed for non-dispatchable measures that are *not weather sensitive* and reduce load across pre-defined hours (e.g., lighting, motors, distributed generation, etc.).
- On-Peak Demand Resources must reduce load during the following hours:
  - **Summer On-Peak Hours:** 1 p.m. to 5 p.m. Non-Holiday Week Days in June, July and August
  - **Winter On-Peak Hours:** 5 p.m. to 7 p.m. Non-Holiday Week Days in December and January

Seasonal Peak Demand Resources

- Designed for non-dispatchable, weather-sensitive measures such as energy efficient HVAC measures.
- Seasonal Peak Demand Resources must reduce load during when the ***Real-Time New England Hourly Load*** is equal to or greater than **90%** of the Expected Peak Load Forecast for the applicable Summer or Winter Season.

Real-Time Demand Response Resources

- Designed for dispatchable measures with no air quality permitting restrictions on their use.
- The ISO will send Dispatch Instructions to Real-Time Demand Response Resources.
- The ISO will dispatch Real-Time Demand Response Resources during Day-Ahead Forecasted Peak Load Hours and emergency operating conditions.

Real-Time Emergency Generation Resources

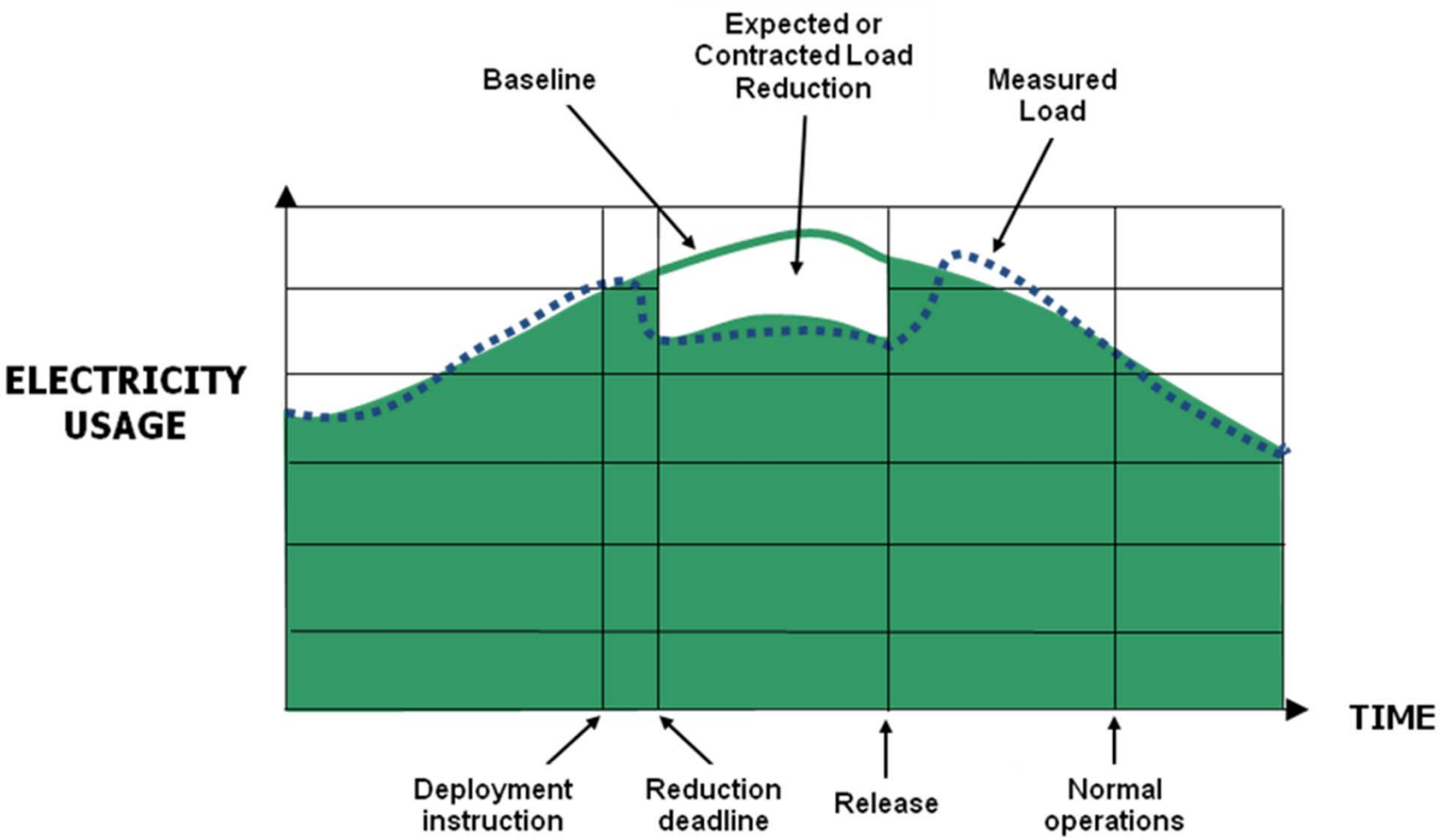
- Designed for Emergency Generators with Federal, State and/or Local air quality permit restrictions.
- The ISO will instruct the Emergency Generators to operate when there are extreme system emergencies that coincide with the ISO implementing 5% voltage reduction.
- The total quantity (MW) of Emergency Generators in the Forward Capacity Market will be limited.

Minimum Criteria for Demand Resources

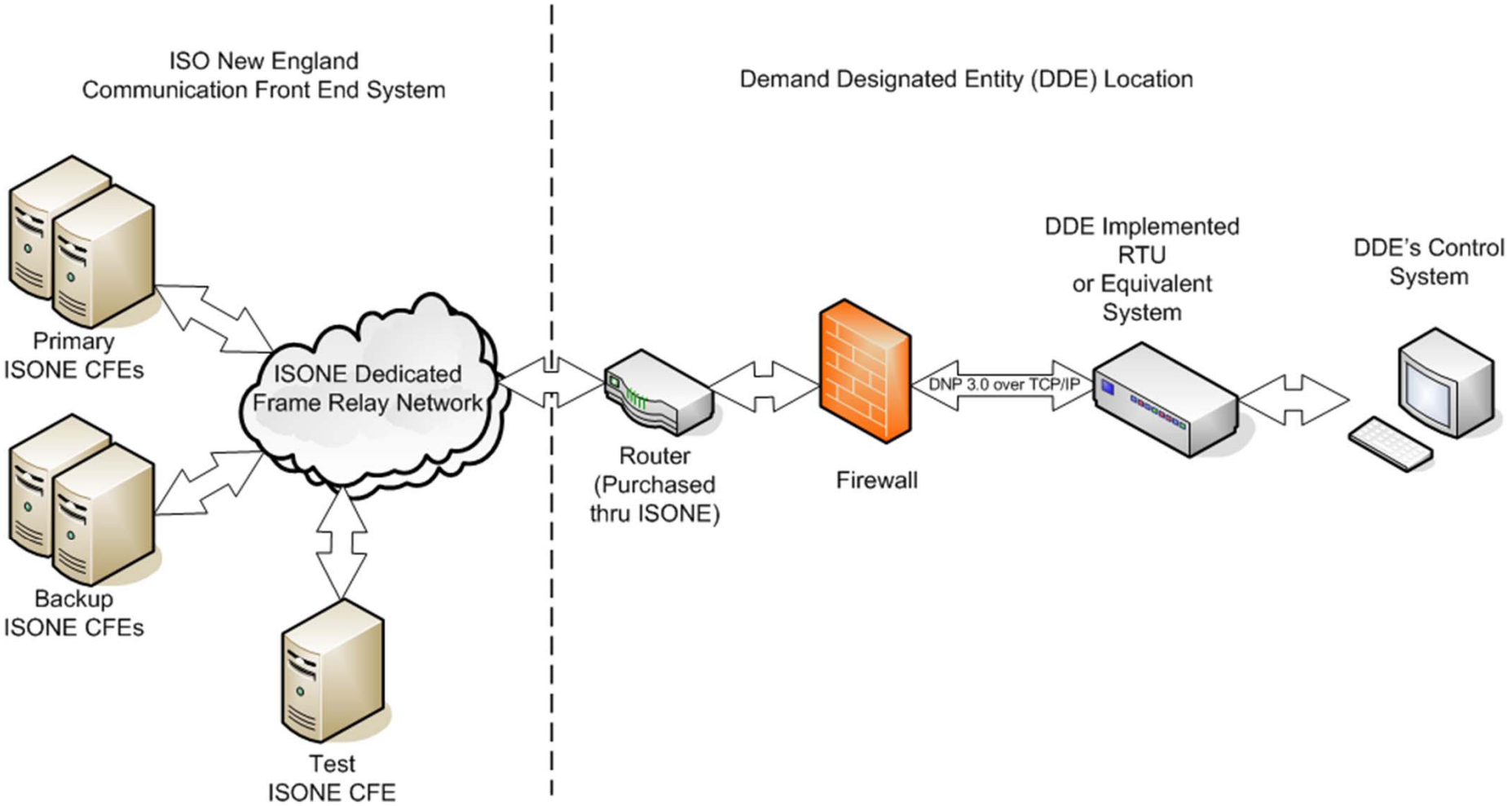
(partial listing)

- Resource size 100kW (or aggregation of smaller)
- Equipment installed after applicable cutoff (approx 48 months before primary delivery date)
- Annual host facility load must exceed name plate rating (DG <5 MW allowed to push back)
- Operation during Resource Type performance hours
- Appropriate metering configuration
- Monthly reporting capability
- Market participant (or part of aggregation)
- Able to post Financial Assurance
- Deliverable to System (Overlapping Impact Test)

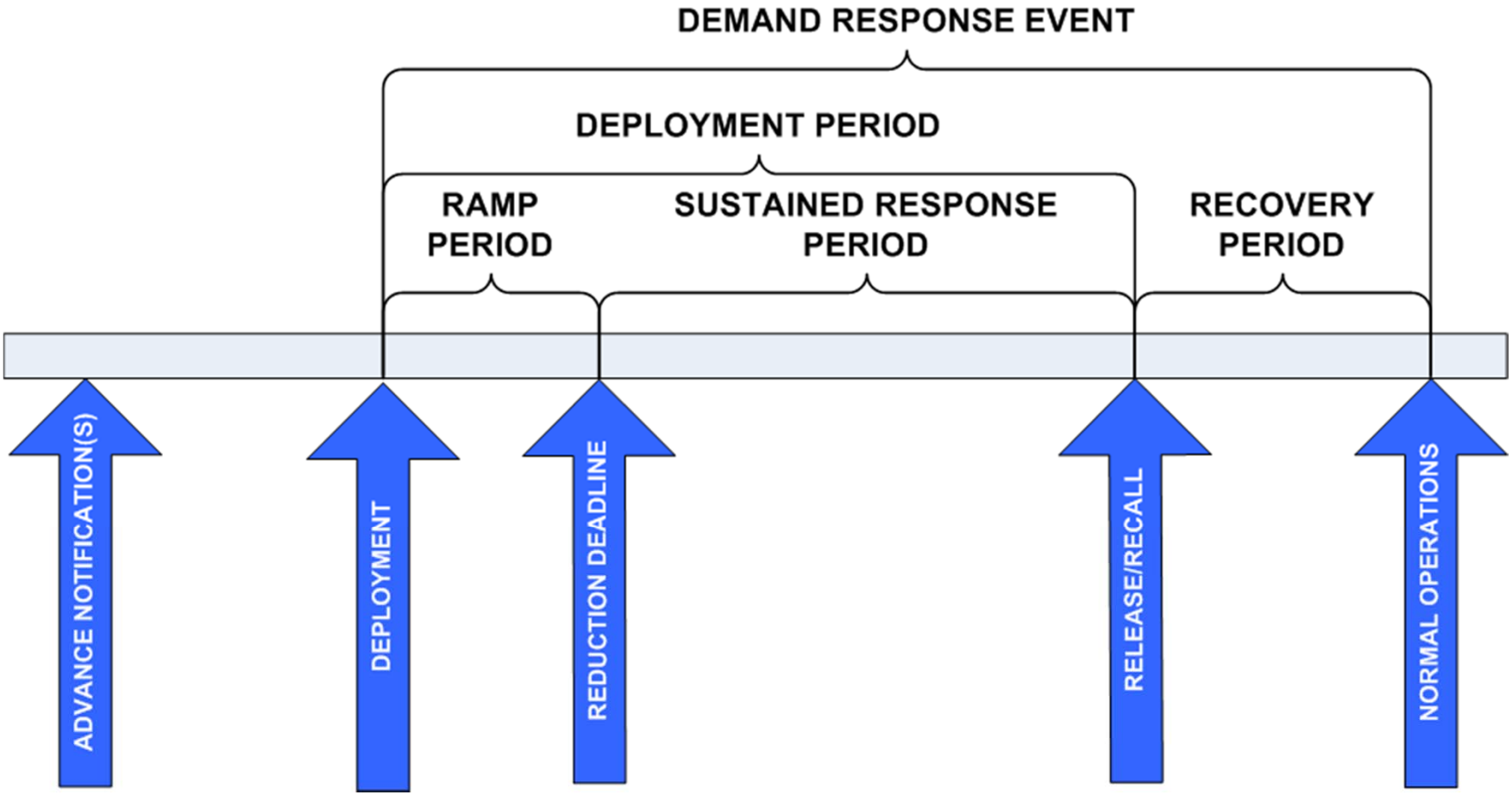
Baseline Conceptualization



DR Dispatch Communication



Demand Response Event Timing

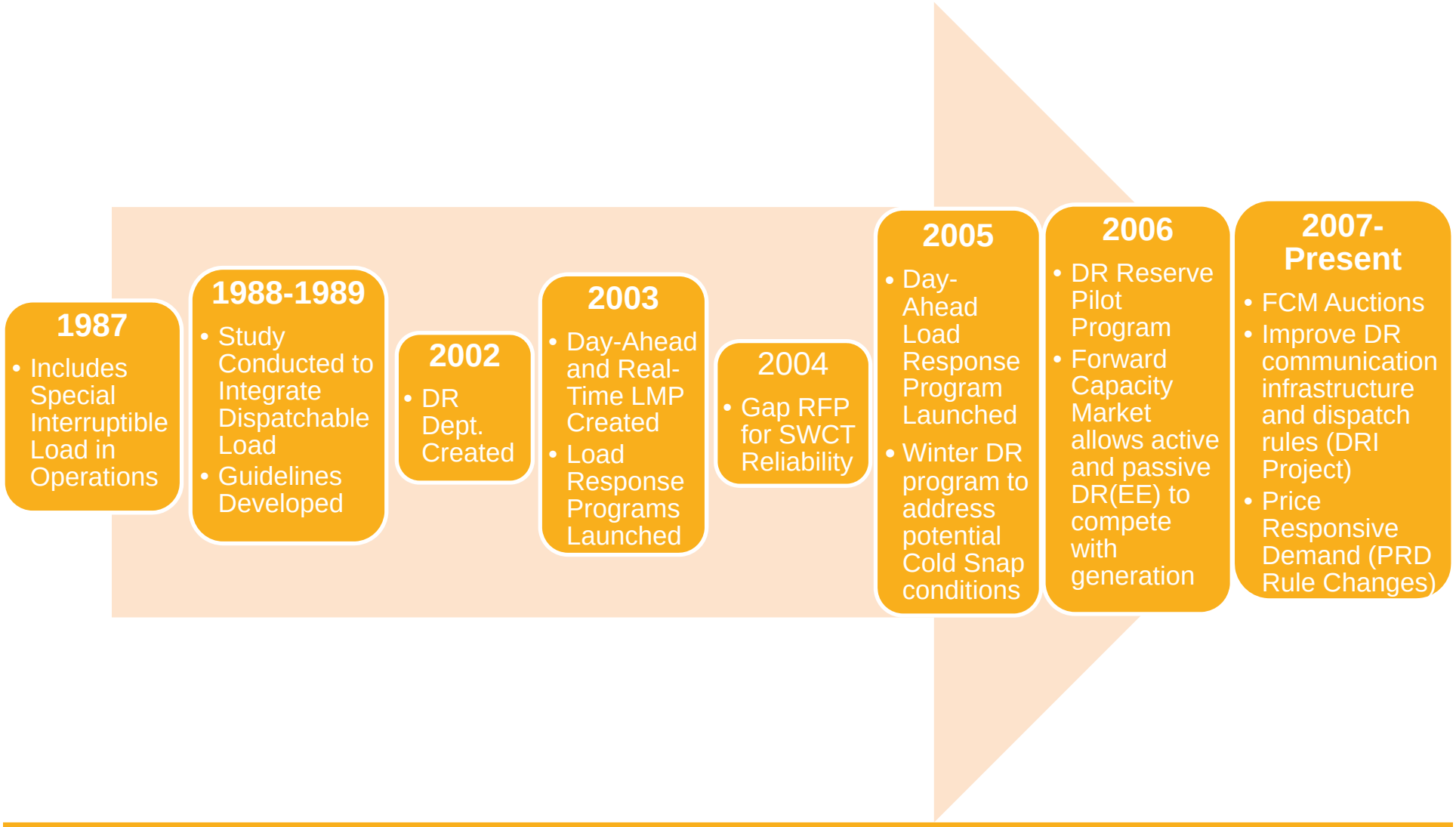


Evolution of Demand Resources in New England

Focus Today is on New England

- Will focus on ISO New England but NYISO, PJM, Midwest ISO, California ISO have all been implementing similar programs
- California ISO was most aggressive in developing Demand Response due to blackout/brownouts in the early 2000s

New England Efforts to Expand DR



1987 Special Interruptible Loads in Operations

- Response to regional capacity shortage
  - Attractive short-term alternative to generating resources
    - Short installation lead time
    - Low equivalent capacity cost
- Interruptible under capacity deficiency
  - Callable when system is short of capacity to meet load and operating reserve
  - This type of resource provided “emergency” capacity
- Interruptible loads supplied by NEPOOL participants
  - Interruptible loads signed up by NEPOOL participants
  - NEPOOL participants get a direct monetary compensation for these special interruptible loads
- Temporary fix to regional capacity shortage

1988 and 1989 Study to Integrate Dispatchable Loads in Operations and Planning

- Interruptible load program very successful
- Determined that dispatchable loads can be a short term and long term resource option
- Used probabilistic study results to identify the impact of various amounts of disptachable loads on New England reliability/resource adequacy and hence, on frequency of their implementation
  - Objective was to maximize the use of disptachable loads while minimizing their impact in other operator actions under capacity deficiency
- Studies were conducted to define the characteristics of these dispatchable loads to make them effective in system operations

1988 and 1989 Study to Integrate Dispatchable Loads in Operations and Planning (cont.)

- Identified that up to 1,000 MW of dispatchable loads in five 200 MW blocks could be accommodated within operations
  - Each block would have different expected frequency of interruption on an annual and monthly basis
    - Determined based on statistical analysis at resource adequacy planning criterion of 1 days in 10 years Loss of Load Expectation
  - There are three notification times established for these dispatchable loads (1 hour, 4 hours and 12 hours)
    - Dispatchable loads with longer notification times will require additional allowed interruptions to account for occasions on which a capacity shortage is anticipated but fails to materialize
  - NEPOOL participants would be compensated through their load reduction credit
    - Reduction in capacity and energy costs due to lower peak load share of the regional loads

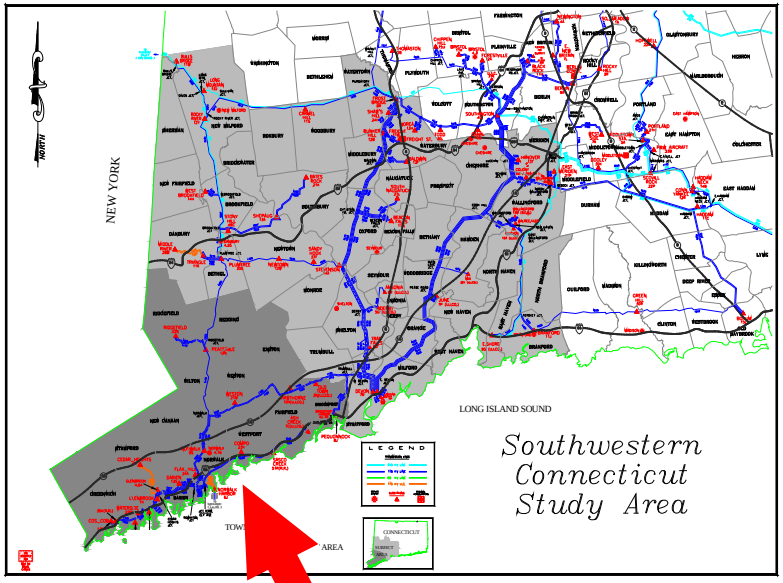
1988 and 1989 Study to Integrate Dispatchable Loads in Operations and Planning (cont.)

- Studies conducted to identify the impact of the dispatchable loads on peak load reduction
- Guidelines developed for use in qualifying demand-side management resources as dispatchable loads
- Studied the performance of special interruptible and dispatchable loads
- Compared the contracted amount of the various types of dispatchable loads with the realized load reduction achieved for the region-wide capacity shortage conditions in 1989
  - Results shown approximately 52% of the contracted amount of dispatchable loads were realized in actual operations
- Planning assumed only half of the amount contracted
  - to reflect the expected achievement of these resources and
  - avoid over counting their performance

2003 Load Response Programs

- Intended to pay for two different categories of Load Response
- Load Response to Capacity Deficiency
  - During rare events of Capacity Deficiency these resources allowed themselves to be the first to be shed upon an order from the ISO
  - Payment was based upon the higher of the LMP during the event or a minimum price
  - This type of resource provided “emergency” capacity
- Load Response to price
  - Original was simply any price greater than a set threshold
  - At that price any Load Response provider was paid the higher of the LMP or the threshold for reductions
  - Incentive was high in order to increase participation

2004 Southwest Connecticut Gap RFP

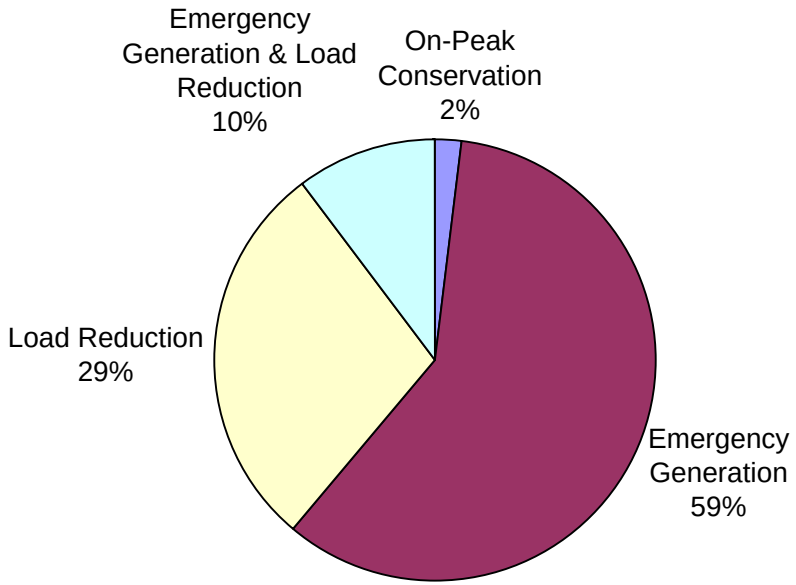


16 Preferred Towns

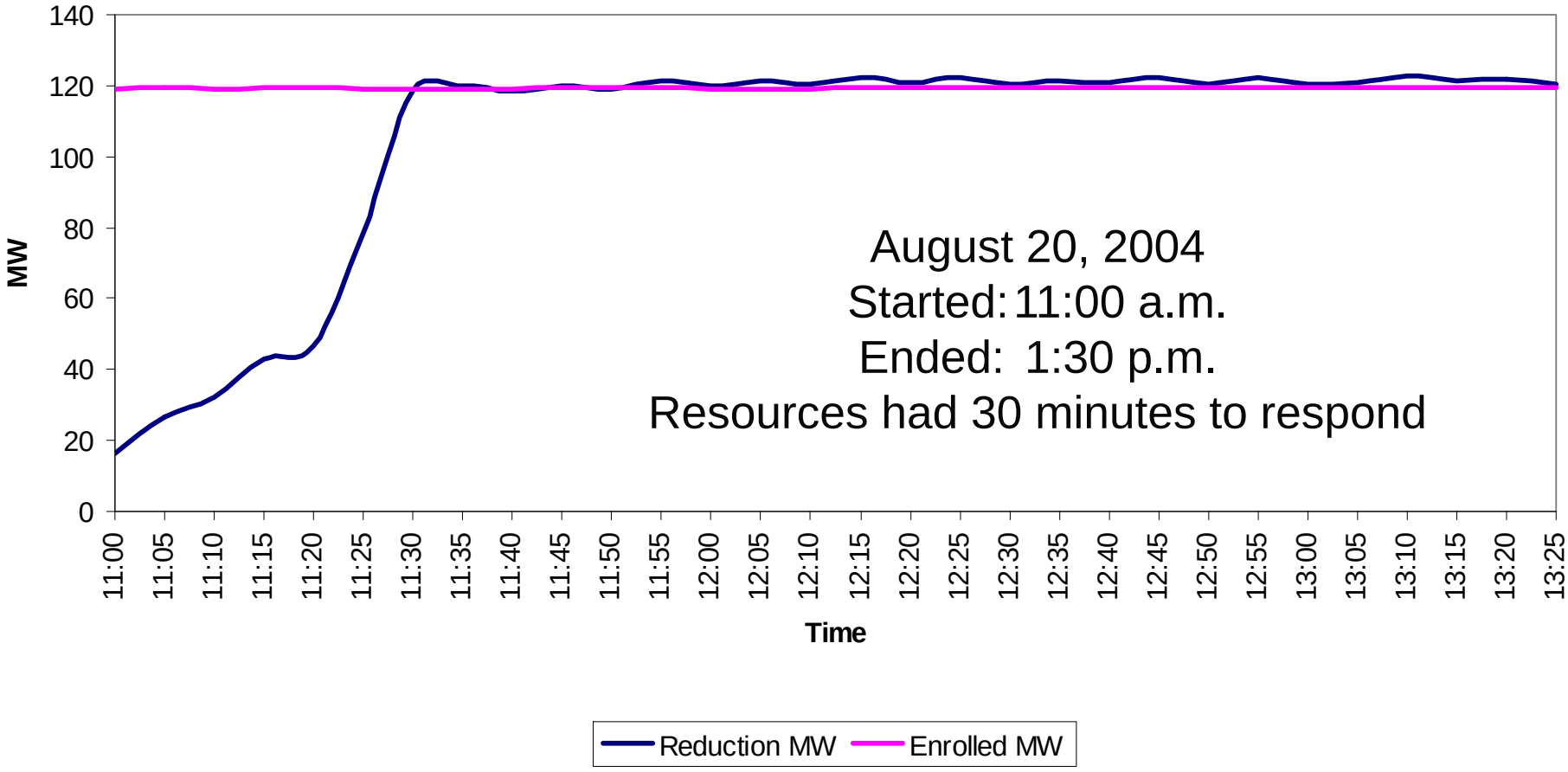
- New local resources and transmission lines badly needed, but delayed, creating a “reliability gap”
- RFP to fill gap issued Dec. 2003
  - For up to **300 MW** of new emergency resources in SWCT for **4 years**
- 34 Proposals Received
- 100% Performance-Based Contracts
- Selected resources: Demand Response or On-Peak Conservation

2004 Summary of Selected Gap RFP Resources

	Summer MW			
Project Type	**2004**	**2005**	**2006**	**2007**
On-Peak Conservation	1	4	5	5
Emergency Generation	94	153	154	154
Load Reduction	22	53	74	74
Emergency Generation & Load Reduction	3	12	22	27
Total	**119**	**222**	**254**	**260**



2004 SWCT Gap RFP Resources Performance



2005 Day-Ahead Load Response Program

- Program launched for all Real-Time Price and Real-Time Demand Response participants
- Option to submit a 2-part Day-Ahead “offer” - $/MWh and $/Curtailment
- Can specify a minimum interruption duration of 1-4 hours
- Offer is accepted if less than Day-Ahead LMP
- If bid accepted, reduction is expected for the following day
- DR is paid the Day-Ahead LMP. Any load deviations (+/-) purchased from or paid at the Real-Time Price

2005 DR Winter Supplemental Program

- To address potential cold snap conditions
- Held December 2005 – March 2006
- Maximum of 450 MW can participate, first come, first served
- Receive supplemental payment based on the actual average hourly MW performance of their resources during each month of the Program Period
- If a resource fails to achieve a maximum interruption of at least 70 percent of its registered capacity during a month, then the Supplemental Payment for the month is zero.
- Can be located anywhere in New England

2006 DR Reserve Pilot Program

- DR is not eligible to provide reserves to the wholesale electric system
  - Dispatchable demands are eligible to provide reserves under this program
- 50 MW test over a multi-year period to demonstrate performance during reserve activation events
- Can Demand Response provide a product similar to 10 and 30-minute spinning and non-spinning reserves?

2006 DR Reserve Pilot Program (cont.) Participating Asset Types

- **Load Reduction**
  - The most common load reduction technology/strategy included lighting and HVAC usage
  - Asset performance was assessed by comparing actual metered load during an event to an asset-specific estimated baseline
- **Behind-the-Meter Generation**
  - Asset performance assessed solely on the metered generation at the time of an event
- **Direct Load Control**
  - Centralized control of a specific end-use across a large number of small customers – e.g., residential air conditioner curtailment
  - Asset performance was assessed by comparing actual metered load during an event to a control group

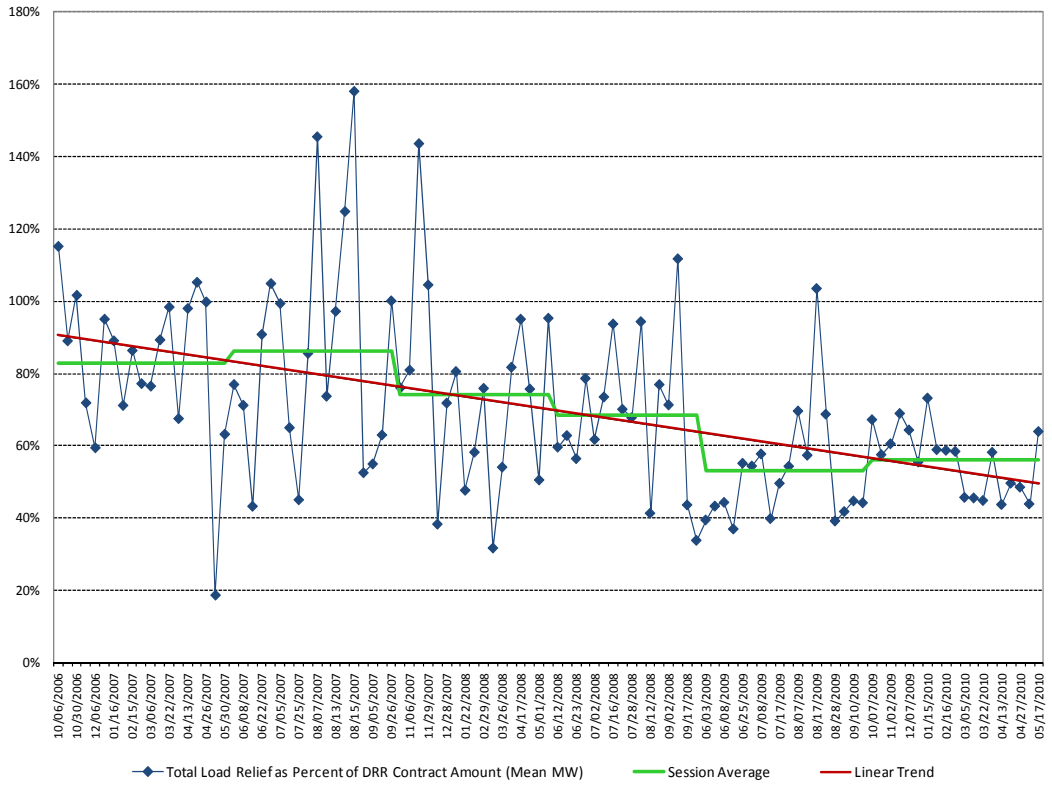
2006 DR Reserve Pilot Program (cont.) Participating Industries

- Grocery Stores
- Manufacturing
- Large Retail
- Education Sector
- Wastewater Treatment Facilities
- Aggregated Air Conditioning Curtailment
- Behind-the-Meter Generators (regardless of their industry of origin)

2006 DR Reserve Pilot Program (cont.)
Pilot Summary

- Pilot ran from October 2006 to May 2010
  - Asset types include load reductions, Behind the Meter Generation, direct load control (i.e. aggregated air conditioner curtailment)
    - 109 assets participated in at least one season; 35 assets participated in all seasons
  - Assets enrolled in six seasons; 26.4 MW per season on average
  - 107 events

DR Reserve Pilot Performance



2006 DR Reserve Pilot Program (cont.) Comparing the Performance of Pilot Program Assets and Generation Resources

- Participating pilot program assets showed less reliability than generation resources (i.e., in-front of meter generators)

- In-front-of-the-meter generation resources showed a moderate increase in reliability since the pilot program started, while pilot program assets showed a decrease in reliability during the same time frame

2007-Present: Forward Capacity Market (FCM)

- Procure capacity to meet region's forecasted demand and reserve requirements approximately 3 years in advance
- Provide compensation for the capacity cost of an existing Generation, Import or Demand Resource
- Attract new resources to constrained regions
  - Allow new capacity projects to compete in market and set price
  - Include new categories of resources beyond traditional supply resources
    - Demand Resources including energy efficiency
    - Intermittent Generation (e.g., Wind, Hydro, Solar)
  - Comparability between DR and generation
- Penalty for not providing capacity during a shortage event

2007-Present: Demand Resources in FCM

- Demand Resources in the FCM are installed measures that result in additional and verifiable reductions in end-use electricity demand in the New England Control Area
- Verifiable reductions serve to reduce the peak demand (permanently across on-peak hours or in response to ISO dispatch) and to maintain operating reserves, avoiding the construction and/or dispatch of additional generation
- Demand Resources include:
  - Energy Efficiency
  - Load Management
  - Distributed Generation
- Minimum size of 100 kW
- Substantial participation

2007-Present: Demand Resource Infrastructure

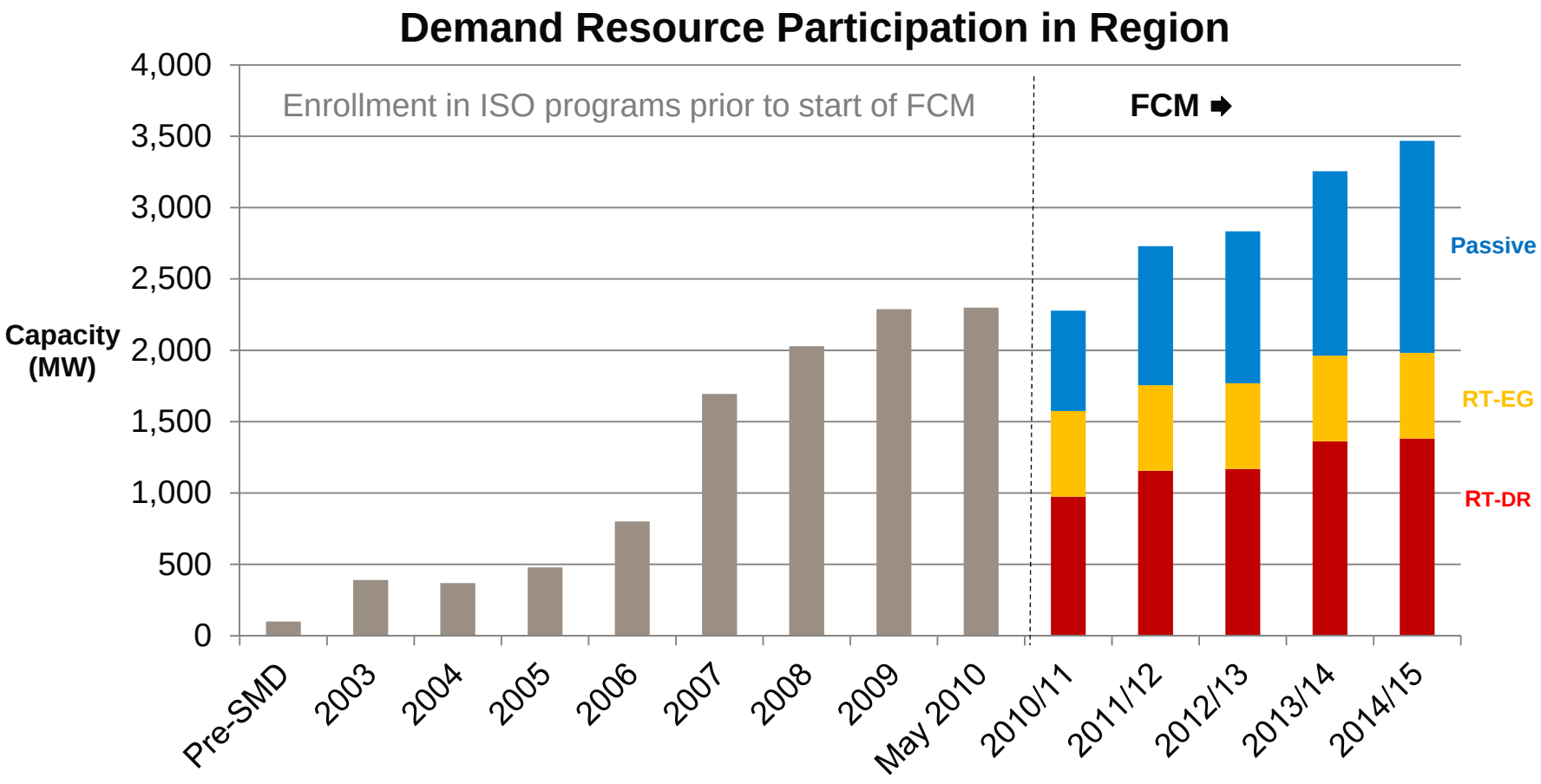
- Significant investment in metering and communication tools
- Demand Resource information systems:
  - Integrates demand response resource information into the systems that monitor the electricity grid and dispatches resources to serve load
    - Interval metered load data
      - Information from thousands of facilities that provide load reductions when the system is capacity deficient
    - Interruption instructions
      - Send instructions on when and how much load to interrupt when needed
    - Hourly availability
    - Customer baseline methodology
      - Calculate load reductions using a customer baseline methodology

2007-Present: Efforts to Integrate PRD into Energy Market

- October 2008
  - ISO started a region-wide stakeholder process to determine the best way to encourage more Price-Responsive Demand (PRD) in the Energy Market
    - Over 3 dozen stakeholder meetings over the past 3 years
    - Strong disagreement expressed on the issue of compensation
- March 2010, FERC issued Notice of Proposed Rule Making
  - FERC's goal is to establish a national policy on the appropriate payment rate for demand response participating in energy markets
  - Final order 745 issued March 15, 2011

Demand Resource Participation in New England

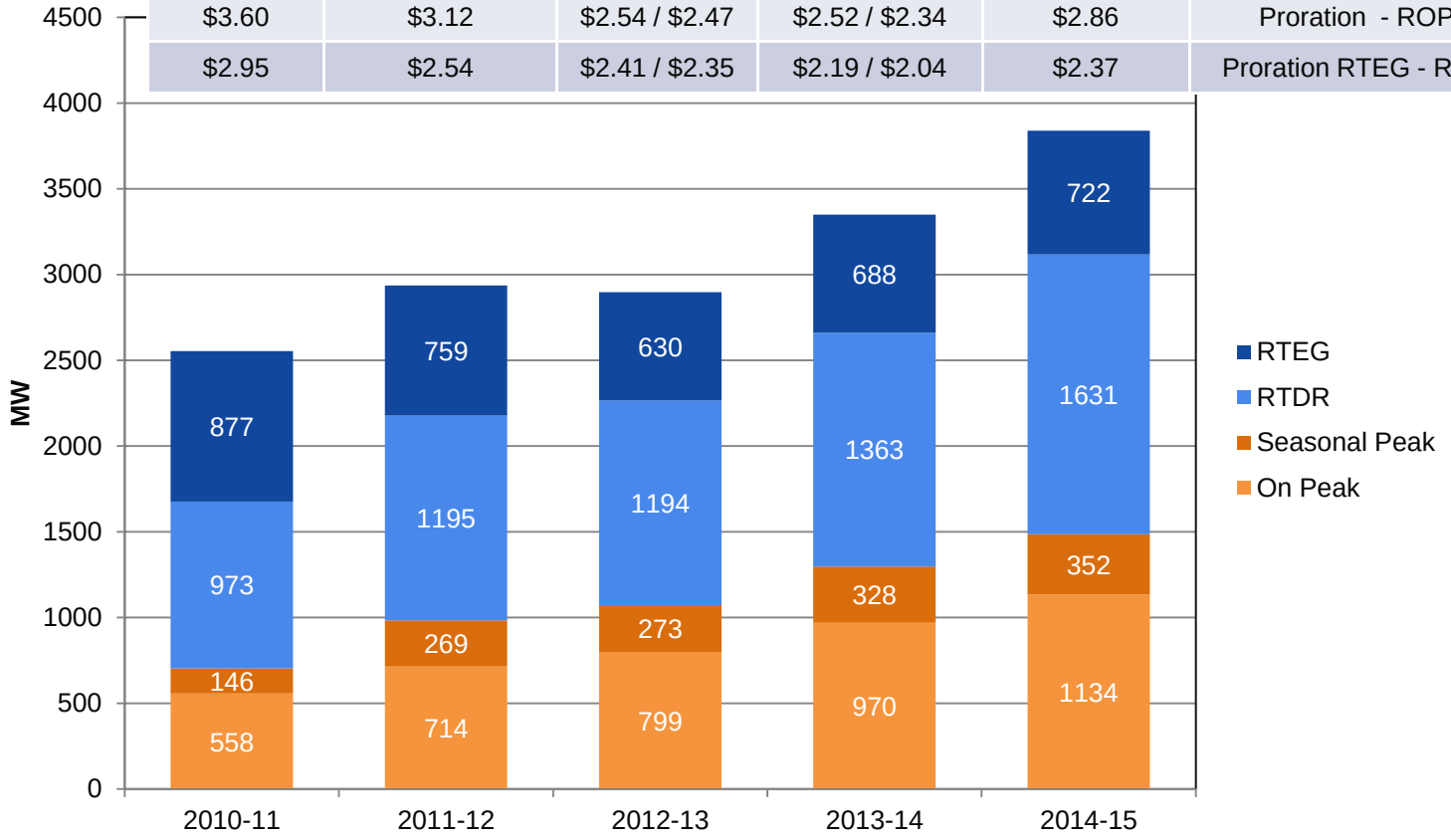
Demand Resources Growing in New England



2010/11–2014/15: Total DR cleared in FCAs 1–5 (New and Existing); Real-Time Emergency Generation capped at 600 MW.

Demand Resource
All Cleared Capacity by Type

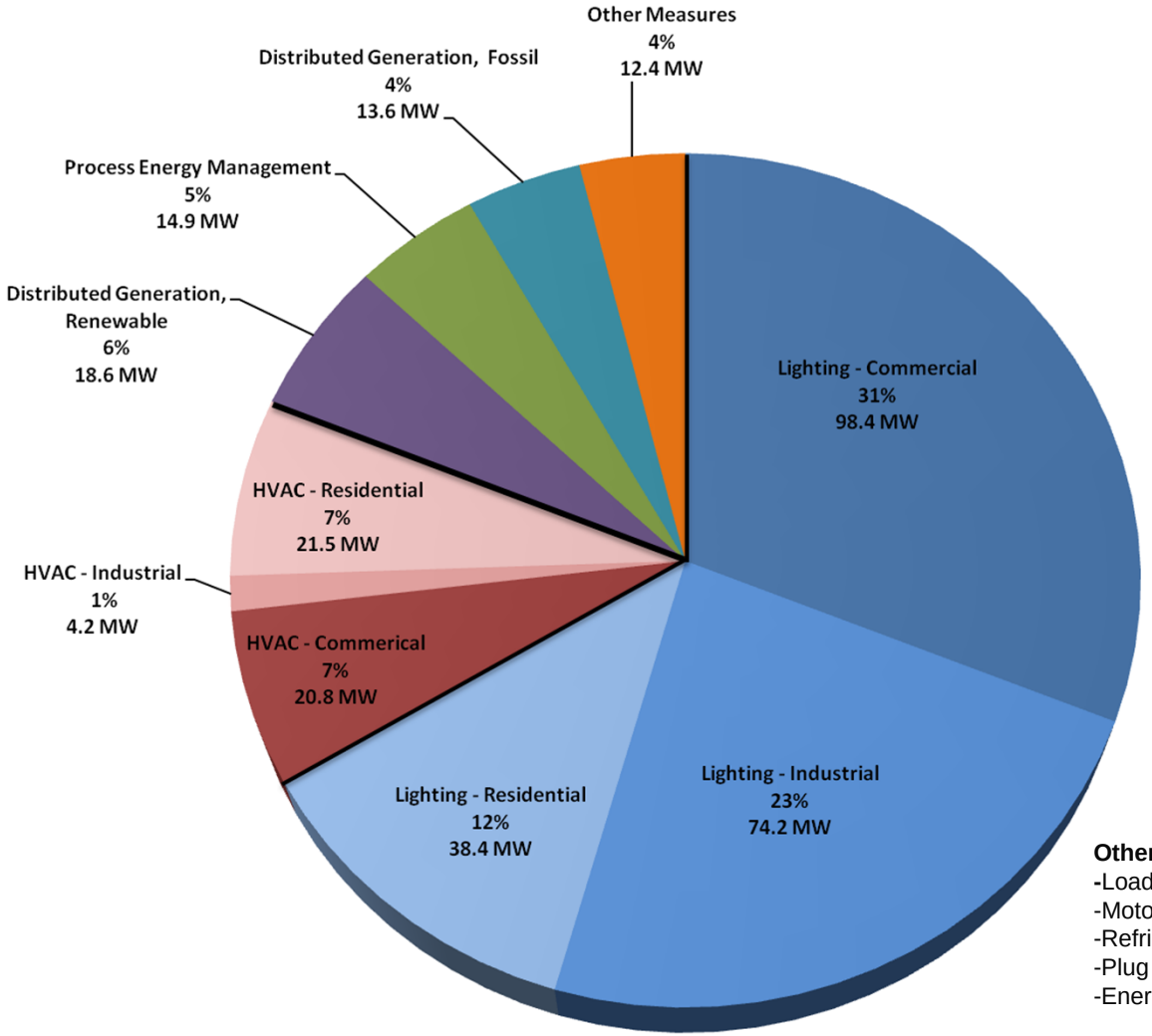
FCA 1	FCA 2	FCA 3	FCA 4	FCA 5	
$4.50	$4.26	$2.95	$2.95	$3.21	Clearing Price
$3.60	$3.12	$2.54 / $2.47	$2.52 / $2.34	$2.86	Proration - ROP/ME
$2.95	$2.54	$2.41 / $2.35	$2.19 / $2.04	$2.37	Proration RTEG - ROP/ME



ROP/ME = Rest of Pool/Maine Capacity Zones

Capacity Values include 8% T&D gross up.

On-Peak and Seasonal Peak Demand Resources Distribution of Measures CP 2014-15



Other Measures:
-Load Management: 1.3 MW
-Motors/Fans/Pumps/Compressors: 2.1 MW
-Refrigeration: 2.2 MW
-Plug Loads/Appliances: 2.9 MW
-Energy Management Systems: 3.9 MW

Forward Capacity Auction Value of Demand Resources *($ Millions)*

	Capacity Commitment Period					
	2010-11	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**Grand Total**
Real-Time Emergency Generation Resource	$30	$22	$18	$17	$20	**$106**
Real-Time Demand Response Resource	$48	$44	$37	$42	$48	**$218**
Seasonal Peak Demand Resource	$7	$10	$8	$10	$12	**$48**
On-Peak Demand Resource	$28	$29	$27	$32	$41	**$158**
Grand Total	**$113**	**$104**	**$90**	**$101**	**$121**	**$530**

*Values include FCA applicable gross-up
**Values are valid as of auction filing CSOs and do not reflect in secondary auctions or bilateral contracts

June and July 2011 Audits of RTDR and RTEG Resources

Initial Audit Results by Load Zone
June 2011

Load Zone	Net CSO (MW)	Initial Performance (MW)	Percent Net CSO
CT	291	267	91.8%
ME	196	217	110.7%
NEMA	98	92	93.9%
NH	60	51	85.0%
RI	66	57	86.4%
SEMA	60	51	85.0%
VT	40	39	97.5%
WCMA	128	81	63.3%
TOTAL	**939**	**855**	91.1%

Initial Audit Results by Load Zone
July 2011

Load Zone	Net CSO (MW)	Initial Performance (MW)	Percent Net CSO
CT	28.4	22.6	80%
ME	1.4	3.1	221%
NH	1.4	1.2	86%
VT	6.2	8.1	131%
WCMA	1.4	0.4	29%
TOTAL	**38.8**	**35.4**	**91%**

Initial Audit Results by Resource Type
June 2011

Resource Type	Net CSO (MW)	Initial Performance (MW)	Percent Net CSO
RTDR	609	518	85.1%
RTEG	330	337	102.1%
Total	**939**	**855**	**91.1%**

Initial Audit Results by Resource Type
July 2011

Resource Type	Net CSO (MW)	Initial Performance (MW)	Percent Net CSO
RTDR	33.5	32.1	96%
RTEG	5.3	3.3	62%
Total	**38.8**	**35.4**	**91%**

July 22, 2011 Dispatch of RTDR Resources

July 22, 2011 Dispatch of RTDR Resources
Summary of RTDR Dispatch Instructions

Issue Time	Effective Time	MW dispatched	Percent Net CSO
12:16	12:50	300	47%
13:16	13:50	643	100%
16:42	16:45	300	47%
17:32	17:35	0	0%

Initial Performance During 100% RTDR Dispatch on July 22, 2011

ISO-NE System – All Dispatch Zones	Total Net Capacity Supply Obligation (MW)	Initial Average Performance During 100% Dispatch Period (MW)	Initial Avg. Performance During 100% Dispatch Period Capped at Net CSO (MW)	Percent Avg. Performance vs. Net CSO	Percent Avg. Performance vs. Net CSO Resources Capped at their Net CSO
100% net CSO Dispatch Effective 13:50 to 16:45 Local Time	642.9	647.8	542.2	100.8%	83.7%

Initial Hourly Integrated Values – 7/22/11

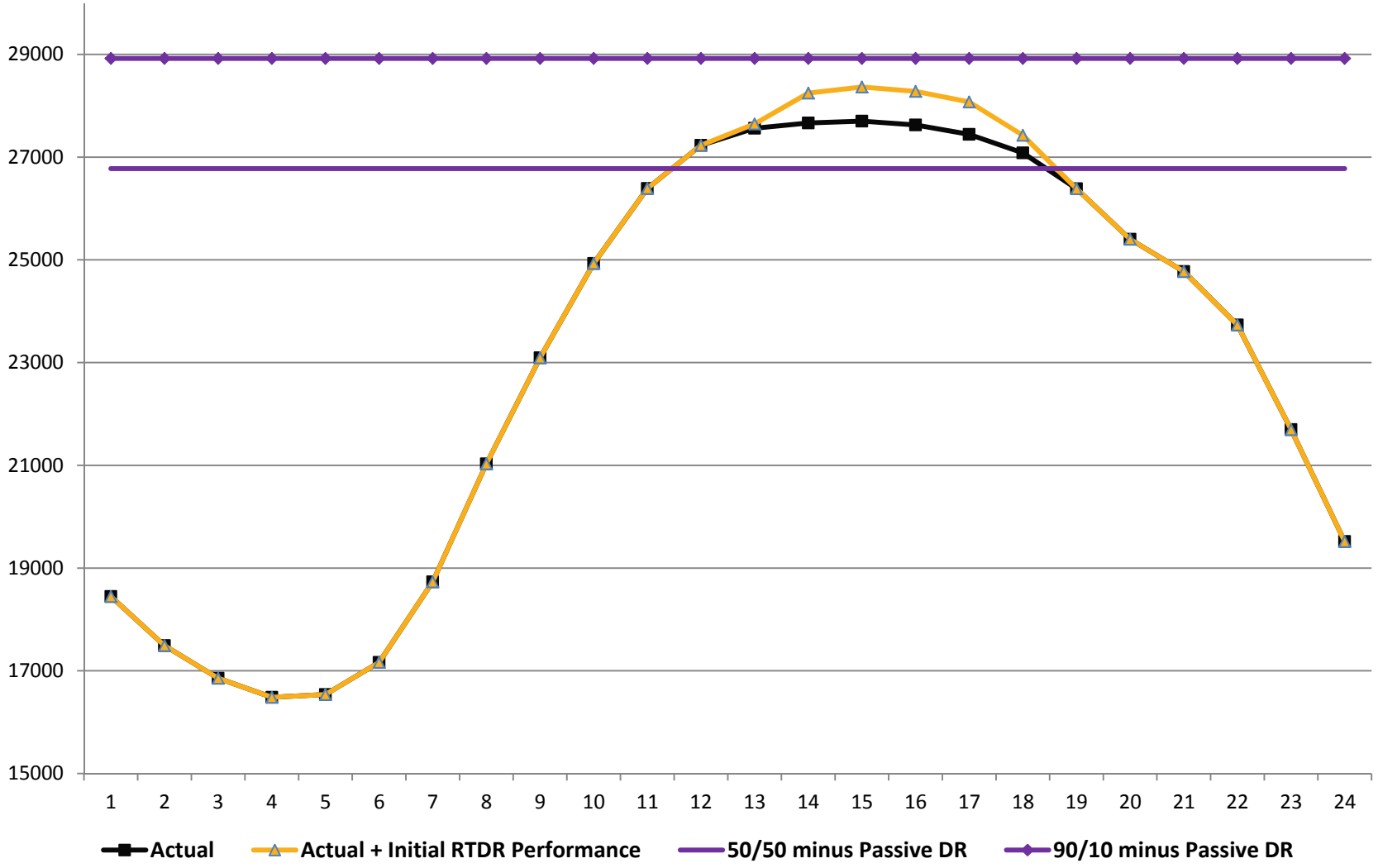
Local Hour End	Effective Dispatch Level (MW)	Real Time Event Initial Hourly Performance (MW)	Performance as % of Effective Dispatch
13	50	84.1	168%
14	357.2	581.3	163%
15	642.9	662.5	103%
16	642.9	655.7	102%
17	557.2	629.3	113%
18	175	343.1	196%

Over-performance as well as under-performance is a concern of System Operators. It is important for resources to meet their dispatch instruction.

State Level Initial Performance Summary

		Period of 100% Dispatch (13:50-16:45)		Hourly Integrated Values					
State	NET CSO for RTDR (MW)	Initial Performance Across 100% Dispatch Intervals	Initial Performance as a % of Dispatch	Initial Performance Hour Ending 13	Initial Performance Hour Ending 14	Initial Performance Hour Ending 15	Initial Performance Hour Ending 16	Initial Performance Hour Ending 17	Initial Performance Hour Ending 18
CT	148.2	129.1	87%	14.0	107.1	130.6	130.4	123.8	60.2
MA	187.5	184.2	98%	22.3	160.6	189.6	184.3	175.7	97.1
ME	180.8	232.1	128%	34.7	221.5	234.8	235.2	230.9	132.3
NH	36.0	34.9	97%	4.4	30.6	35.8	35.4	32.4	17.0
RI	50.2	23.3	46%	3.6	23.8	26.7	25.7	23.9	12.0
VT	40.2	44.2	110%	5.1	37.8	45.0	44.7	42.6	24.4
Total Initial Hourly Performance	642.9	647.8		84.1	581.3	662.5	655.7	629.3	343.1
Effective Dispatch Level		642.9		50.0	357.2	642.9	642.9	557.2	175.0
Initial Performance as a % of Effective Dispatch		101%		168%	163%	103%	102%	113%	196%

ISO-NE July 22, 2011 Peak Day (MW)
Actual & 2011 CELT Summer Peak Load Forecast



Future of Demand Resources in New England – Price Responsive Demand

What is Price Responsive Demand (PRD)?

- The better question is “Why isn’t all load price responsive?”
- Since the supply responds to price, especially in markets that produce 5-minute prices in real-time why doesn’t demand?
- How can you have a market if only suppliers respond to prices?

How Do Customers Achieve Reductions?

- Reduce Electricity Consumption
  - Shut down a manufacturing process
  - Turn off discretionary lighting, motors, etc. (Active or Passive)
  - Raise HVAC temperatures (Active or Passive)
  - Use Lighting Controls (i.e., Dimming) (Active or Passive)
  - Use an Energy Management System (Active or Passive)
- Start Emergency Generator
  - Transfer load from the grid to an Emergency Generator
- Combination
  - Start up Emergency Generator and reduce load at the same time

Barriers to PRD in ISO New England

- Most consumers in New England are still charged uniform retail rates
  - Consumers cannot benefit from changing their consumption levels in response to changing real-time wholesale energy prices
  - Smart Grid technology makes little sense under uniform retail rates

- New England lacks advanced metering infrastructure and tools to assist customers to respond to prices
  - Limits ability of suppliers to offer dynamic retail rates
  - Limits the ability to consumers to evaluate dynamic retail offers or the cost-effectiveness of Smart Grid investment opportunities
  - Advanced metering infrastructure investment growing in region

Dynamic Rates for Consumption

- Requires Advanced Metering Infrastructure to be implemented
  - Hourly Interval metering at the customer level
  - Potential for two-way communication to send price signals to the customer to inform consumption decisions
- Also may really require “smart devices” to allow heavy draw devices that can be “scheduled” to consume when prices are low
  - Refrigerators (to some extent)
  - Clothes Dryers/dishwashers
  - Air Conditioners (compressors)
- Some industrial/commercial customers may already have infrastructure in place to reduce consumption
  - Walmart in US stores can reduce consumption on demand

Future of Demand Response

- Treat Demand Response as “Supply”
  - Allow them to Offer into the Market
  - Take their offers when it is it economically efficient (more on this next page)
  - Send them a dispatch instruction (like we do for generators)
  - Pay those that respond the LMP (Locational Marginal Price) for the megawatts that they did not consume (Negawatts)
  - This identifies one of the major problems, how does one measure “Negawatts”?
  - Negawatts are measured by determining a “baseline”, which is a “guesstimate” of the amount the demand would have consumed had they not “responded” and then compare that to the actual consumption, the difference is the Negawatts. Requires more than AMI (since some system must calculate baseline).

Future implementation PRD

- Net Benefit Test
  - FERC Ordered the ISO to continue to investigate a “dynamic net benefit test” to be implemented during RT dispatch
  - Until the time the previous test is implement a minimum offer price (threshold) will be used
  - At this offer price (and above) the acceptance of a Demand Offer will tend to lower the LMPs for the remaining demand enough to pay for Negawatts
    - For example if the LMP would lower for 20,000 Mwh by $1 then a payment to 100 Mwh of Negawatts @ an LMP of $100 would still be cost beneficially to the 20,000 Mwh of load.
  - Determining the threshold will be an interesting exercise

FERC Order 745

- Payment
  - Demand-response providers must be paid the full LMP when:
    - Demand response resources have the capability to balance supply and demand; and
    - Payment when it is cost effective, as defined by a ***net-benefits test***, to dispatch demand-response resources
- Baseline
  - ISO/RTOs directed to evaluate current measurement and verification rules and modify, if necessary, to ensure that baselines remain accurate
- Cost Allocation
  - ISO/RTOs must allocate costs associated with demand response proportionally to all entities that purchase from the relevant energy market where the demand response reduces LMPs

ISO New England Order 745 Compliance

- To comply with Order 745, ISO New England proposed market rules that treat demand response like generation
  - Demand response bids a price and quantity of demand reduction just as a generator bids a price and quantity of generation
  - All bids subject to the same commitment, dispatch, settlement process
- ISO New England's August 19, 2011 compliance filing included two areas of market rule changes:
  - **Rules for an integrated solution:** New market rules that fully integrate demand response into energy markets and system infrastructure that conform to the Commission's order, to be implemented June 1, 2015
  - **Rules for a transitional program:** Consolidate and modify existing price-response programs to comply with the Commission's order
    - Current price-response programs (implemented in 2003 and 2005) sunset after May 31, 2012

Questions and Discussion