

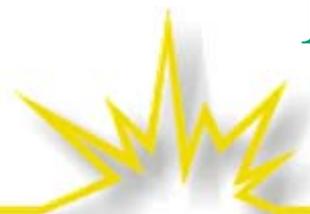
# **“Clean First” Design of Market Incentives for the Power Sector:**

## **A Case Study of Forward Capacity Markets**

Presented by Meg Gottstein, Principal  
The Regulatory Assistance Project  
May 2010

*The Regulatory Assistance Project*

China ♦ India ♦ European Union ♦ Latin America ♦ United States



# The Regulatory Assistance Project (RAP)

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- Non-profit organization providing technical and policy assistance to government officials on energy and environmental issues
- Principals and senior associates are all former regulators or energy officials with deep experience in energy efficiency and other clean energy alternatives
- Funded by several foundations, US DOE & EPA and international agencies
- We have advised governments in over 18 nations and 40 US states; European office in Brussels.



# The Challenge: A Regulatory Framework for the Power Sector That Can:

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Achieve *all* of the following:

- (1) ensure a reliable supply of electricity
- (2) meet the challenge of de-carbonizing the power sector by 2050
- (3) do so at an affordable cost to consumers
- (4) while engaging private business to innovate and participate in the market

Traditionally, power sector regulations in the US and elsewhere  
--focus on balancing (1) and (3) while achieving (4)  
--often work at cross purposes, rather than in concert with carbon policies and targets

And will continue to do so *unless power sector regulations are crafted to fully align with climate goals....*



# “Clean First”: Aligning Power Sector Regulation with Carbon Reduction Policies and Goals \*

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- **Clean First** is not a single policy, but rather a comprehensive suite of policies and regulations developed from the perspective that *clean resources*—e.g., zero or low-carbon emitting resources—*should get every reasonable preference over resources that have greater carbon emissions*, whether it be in:
  - siting new transmission or building new distribution lines
  - new plant construction (e.g., permitting)
  - access to the transmission system (new interconnections, firm access)
  - cost allocation for transmission (and distribution)
  - **eligibility for market incentives (e.g., capacity payments) in wholesale markets**
  - dispatch (and curtailments)
  - and grid operations generally
- Under Clean First, *meeting climate goals\* becomes part of the mandate for power system regulators*, along with ensuring that the power system is *safe and reliable*, and *affordable* to consumers.
- The *specific policies* will *vary from country to country* as regulators consider country-specific climate and environmental goals and power sector conditions

\*This presentation focuses on aligning regulation with climate goals, recognizing that the concept of “Clean First” applies to aligning power sector regulations with a broad range of environmental goals, including minimizing air and water pollution.



# What are “Forward” Capacity Markets (FCMs)?

## Why Do They Make a Useful Case Study?

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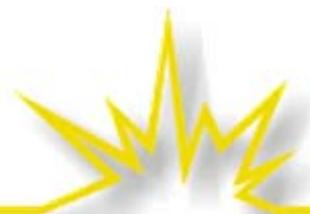
- **FCMs are centralized, administrative markets** run by system operators (e.g., GBSO) to **pay market incentives** (capacity payments) established through a **competitive auction to resources that commit “forward”** (several years in advance of need) **to being available to meet peak demand on the system**
  - The capacity payment (\$/kW-month or \$/MW-day, is a **separate, additional payment** from what the resource gets **from energy (kwh) sales** in the spot or day-ahead market
  - All **“load serving entities”** (regulated or not) **are obligated to pay** their share of these capacity costs, which are then passed on to their consumers in retail prices/rates
- **FCMs and other capacity mechanisms are being explored** as a potential component of the **future regulatory landscape in the UK** to help meet energy goals (Tories, Labour, Ofgem, DECC)
- We **now have several years of experience with FCMs** in the US to **“learn from”** that allow energy efficiency along with other demand-side resources to compete with supply-side resources in the market
- This experience provides a **good example** of where **ambitions for a low carbon economy will require a “Clean First” overlay to the design of FCMs and other capacity mechanisms**



# What's Being Said About Capacity Markets in the UK....

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- Ed Miliband, MP--London Times (February 2010):
  - “We are going to need a **more interventionist energy policy to deliver the low-carbon investment we need**....Changes being considered include....**an overhaul of Britain’s existing new electricity trading arrangements (Neta)**, which have been in place for more than ten years; and the **introduction of “capacity payments”** to guarantee returns to developers of low-carbon sources of power.
- Conservative Policy Green Paper No 15 (March 2010):
  - “In financial markets, the central bank specifies the prudential reserves that other banks in the system have to maintain. **In electricity markets** we believe that the **energy regulator should** have a similar role....In effect, **the regulator would be able to long-term commitments on behalf of consumers to provide certainty of payment for new capacity.**”
- UK Energy Market Assessment (DECC/HM Treasury, March 2010)
  - “[Capacity mechanisms] could **play a role in ensuring energy security**...[They] **reward available capacity, instead of developers receiving all their revenues from electricity sales**....” International experience suggests that **capacity auctions** are likely to be the **most cost-effective** way to implement a capacity mechanism.



# Development of Forward Capacity Markets (FCMs) in the US

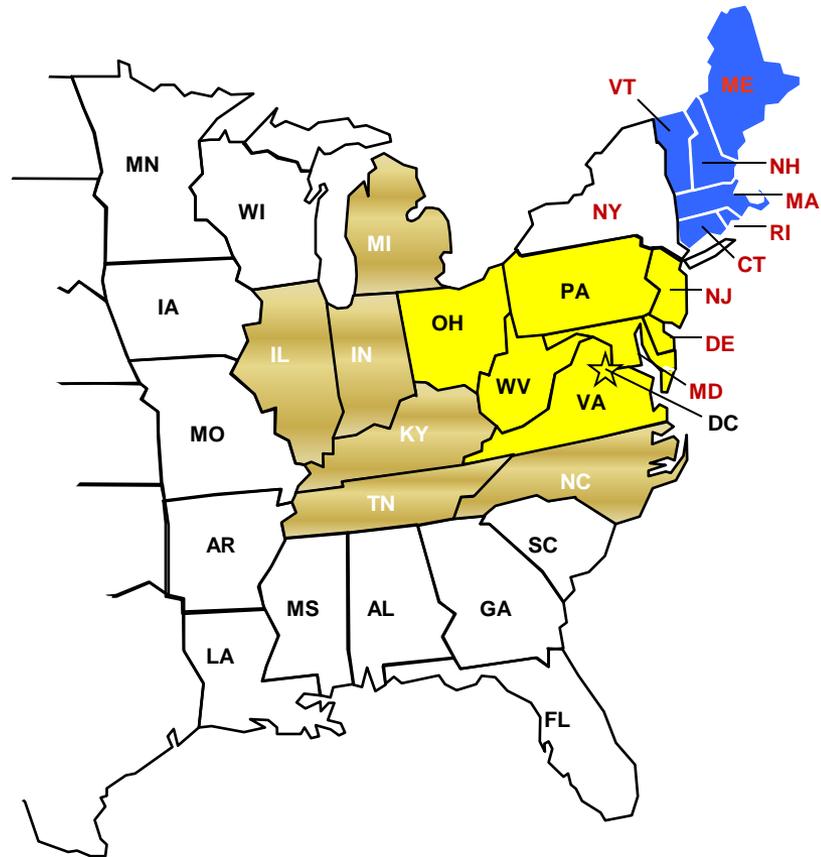
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- **Why:** Resource adequacy (system reliability) in parts of the US not being met with energy-only or short-term capacity markets
  - Massive retirements, few new power plants, and administrative interventions too expensive to consumers.
  - **Energy Security Requires “Resource Adequacy”: Due to the unique serve-all-or-serve none nature of the electric system, a system operator must have a sufficient quantity of capacity available “real time” to call on to meet peak system loads**
- **How:** Federal regulators with extensive stakeholder process:
  - Influenced by a “consumer revolt” (legal action) over the high price tag of capacity contracts in New England
  - Led to a settlement to create a **regulated, centralized market** that **permitted demand-side resources to bid** into the capacity auction
- **Where:** Two organized power markets in the US (see map)

# ISO New England and PJM Territories

FCMs cover regions with installed generation capacity on the order of:

- 22% of the EU-27 member states combined
- The combined installed generation capacity of Poland, Germany and Belgium



## LEGEND

- ISO New England territory
- PJM territory - covers all or most of the state
- PJM territory - covers part of the state



# How FCMs define “Demand-Side” Resources

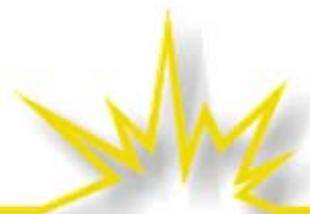
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- Customer-based resources that reduce demand for electricity from the system/grid during all or some hours:
  - **Demand Response**: changes demand in response to dispatch instructions or price (focus on limited peak demand hours)
    - e.g., cooler/refrigerator cycling in grocery stores
  - **Energy Efficiency**: “permanent demand-response”—continuous, permanent reduction
    - e.g., lighting or appliance replacement programs
  - **Distributed Generation**: generating electricity at customer site
    - e.g., on-site combustion or steam-cycle turbine at industry site; back-up generators; rooftop photovoltaics

# Forward Capacity Market (FCM) “Basics”

(It’s not like a market for wheat!)

- **Objective:** Procure sufficient capacity several years in advance of need to meet the region’s forecasted peak demand and reserve requirements, at an affordable (competitive) price
- **How:** Through a regional planning and competitive auction process designed to augment energy markets administrated by the regional **System Operator (SO)**
  - **Planning:** **SO forecasts** regional peak demand for electricity several years ahead
  - **Procurement:** **SO administers** centralized, competitive auction to determine the capacity payments for resources that commit to being available when needed to meet peak load demand (several years in advance of need)
    - **Demand-side and supply-side resources compete** on an equal basis (or nearly so)
    - Auction rules designed to “mimic” **competitive market outcomes**
    - Bids **can come from outside the region**
  - **Payment:** **SO bills** all load-serving entities (utilities, retail energy suppliers) for their share of capacity costs, based on their peak loads, plus reserves



# FCMs: Auction Designed to Mimic Competitive Market Outcomes

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- **FCMs plan for capacity needs several (three) years ahead of need:**
  - System operator projects level of firm capacity needed to meet peak demand (= **Demand Quantity**)
  - Capacity from existing and new resources that can meet that demand is “committed forward” into the auction (= **Supply Quantity**)
- **Clearing price** is established at the lowest auction bid price where supply quantity just equals demand quantity. **Auction rules designed to “mimic” competitive market outcomes:**
  - Generally, only new (marginal) resources set the clearing price
  - All resources bidding at or under the clearing price are eligible for capacity payments
  - Economic “rents” flow to those resources with relatively low marginal costs of providing firm capacity to the system--or those that have already recovered some or all of those costs.



# Are FCMs Achieving Energy Reliability and Security Goals in Terms of Resource Adequacy?

- **Yes**, they are successful in securing a sufficient *quantity of resources (mega-watt capacity)* to meet peak loads in the region
- Including, for the first time in any organized market, *allowing energy efficiency to participate*, with an impressive level of response from all demand-side resources:
  - For the 2012/2013 delivery year, **10,600 MW\*** of **demand side resources cleared** the regional auctions based on price alone to meet resource adequacy needs

\* 1,600 MW of energy efficiency, 8,250 MW demand-response, 750 MW distributed generation



## Demand-Side Resources Meet Energy Supply Goals: Security, Low Carbon, Affordable Cost

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- **By lowering the clearing price paid to all capacity resources in the market, demand-side resources:**
  - Saved ratepayers **as much as \$280 million in ISO-NE first auction**
  - Reduced clearing price in **PJM's recent auction** from \$178.78 to \$16.46 (in uncontrained zones)—**a savings of \$162.32 per MW per day**
- **They reduce carbon emissions\*** and **enhance reliability** down to the distribution system
- **They don't depend on fuel imports** or trans-continental grids

\* Energy efficiency will always reduce emissions; demand-response in some instances may not (because<sup>13</sup> of load shifting); distributed generation—impact on emissions depends on how it is powered .



# Participation of Demand-Side Resources in the Market

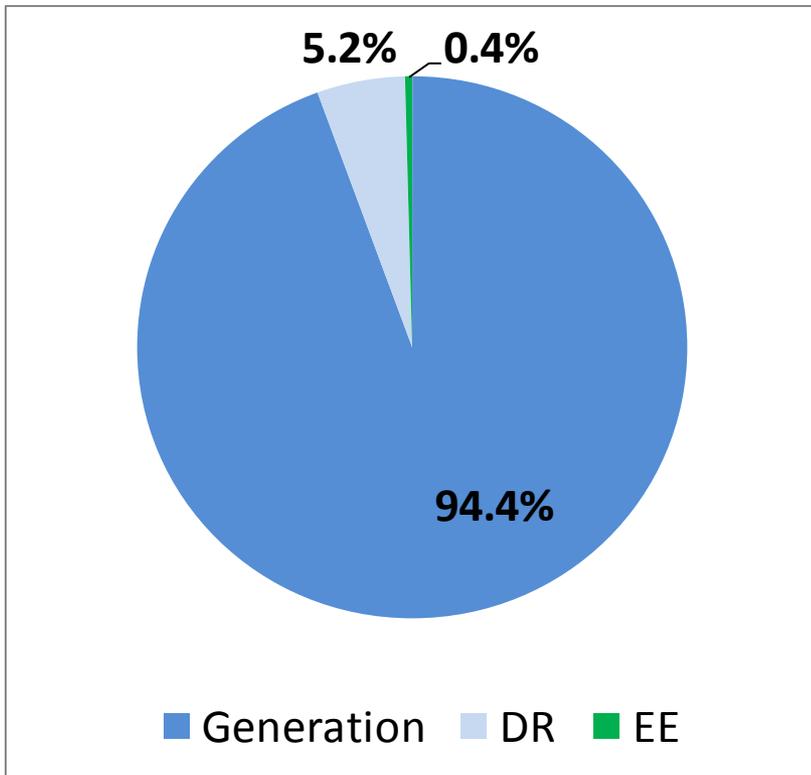
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Work in concert with the goals of promoting a secure, affordable, and low carbon energy supply

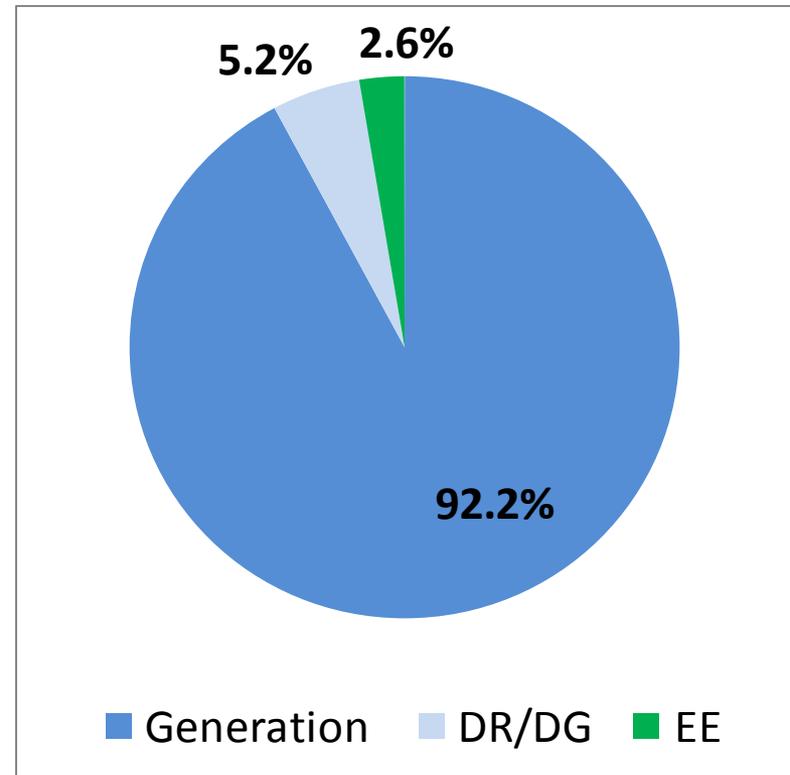
...But That's Not The Whole Picture.....

# Demand- vs. Supply-Side Resources Cleared in 2012/2013 Auctions

## PJM



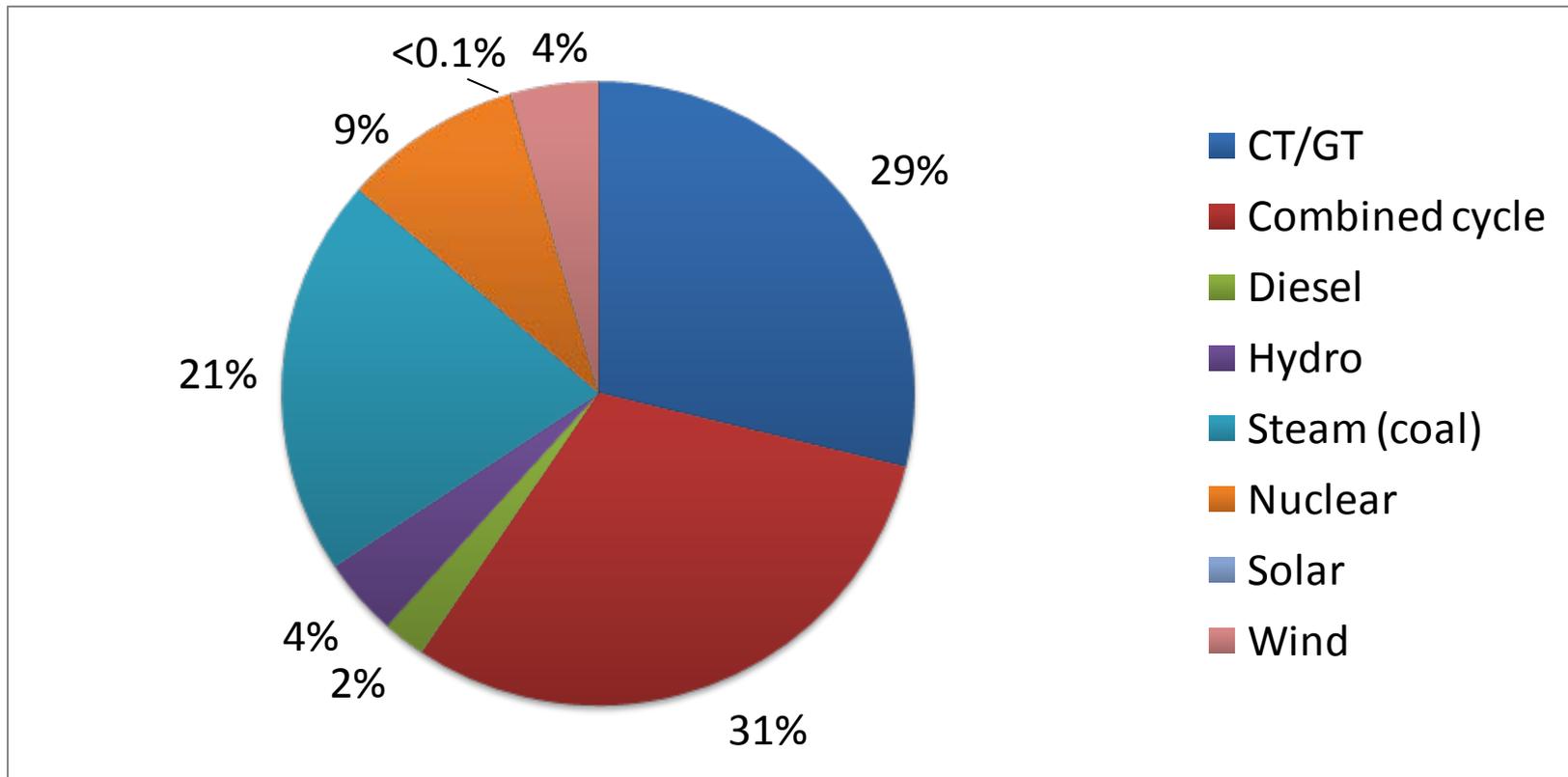
## ISO-NE



Efficiency eligible since 1<sup>st</sup> auction, in 2008

Efficiency not eligible until this auction

# New Supply-Side Resources in PJM Auctions (cumulative)



“New” resources primarily are new-built, reactivated and uprates to natural gas-fired plants, reactivated and uprates to coal-fired plants (plus a new merchant coal plant), uprates to other types of existing plants plus new wind (based on peak capacity factor).



# For the Full Picture, Just “Follow The Money” ....

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## ➤ How Much?

- The most recent auctions (for 2012/2013 delivery year) \*
  - PJM: Capacity payments = **\$3.7 billion for a single year**
  - ISO-NE: Capacity payments = **\$1.1 billion for a single year**

## ➤ The Bulk \$\$\$ Paid to Which Generators?

- **New** capacity is still dominated by the cheapest generation to build, reactivate or uprate (natural gas, coal, nuclear)
- **Existing** base-load nuclear and fossil-fueled generators that have already recovered most of their fixed costs (and make no changes in plant operations also receive the market incentive)

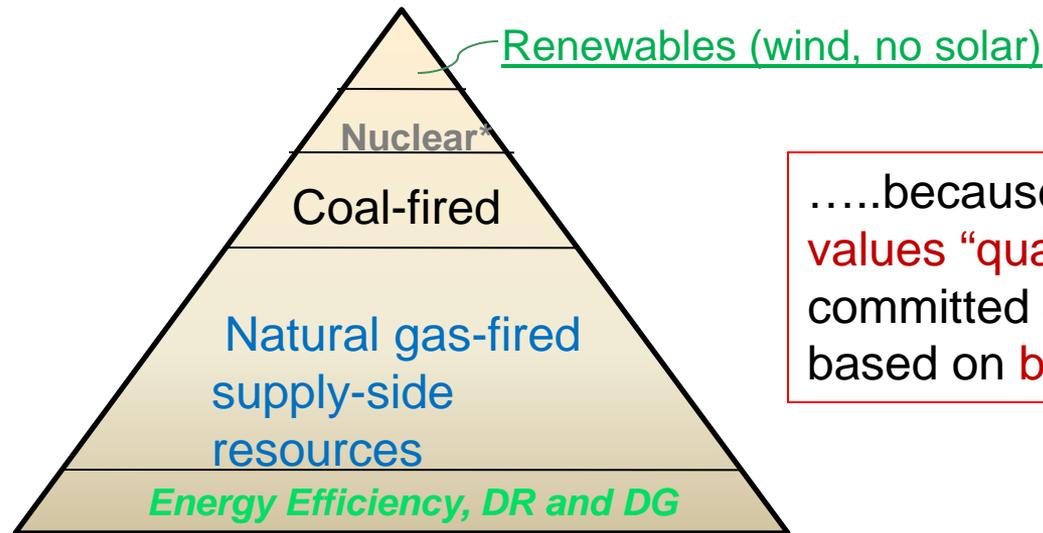


# Lacking a “Clean First” Overlay, FCMs Currently Work at Cross-Purposes with Carbon Goals

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- **As currently designed**—although they are attracting new, clean, cheap demand-side resources, FCM capacity payments are also (in overwhelming quantities):
  - **Breathing “new economic life”** into **existing high-emitting power plants** that operate many (or all) hours of the year, not just to meet peak demand
  - **Improving the cash flow** for **new high-emitting resources** (including a new merchant coal plant)
  - Thereby **“crowding out” renewables** that can meet resource adequacy requirements equally well

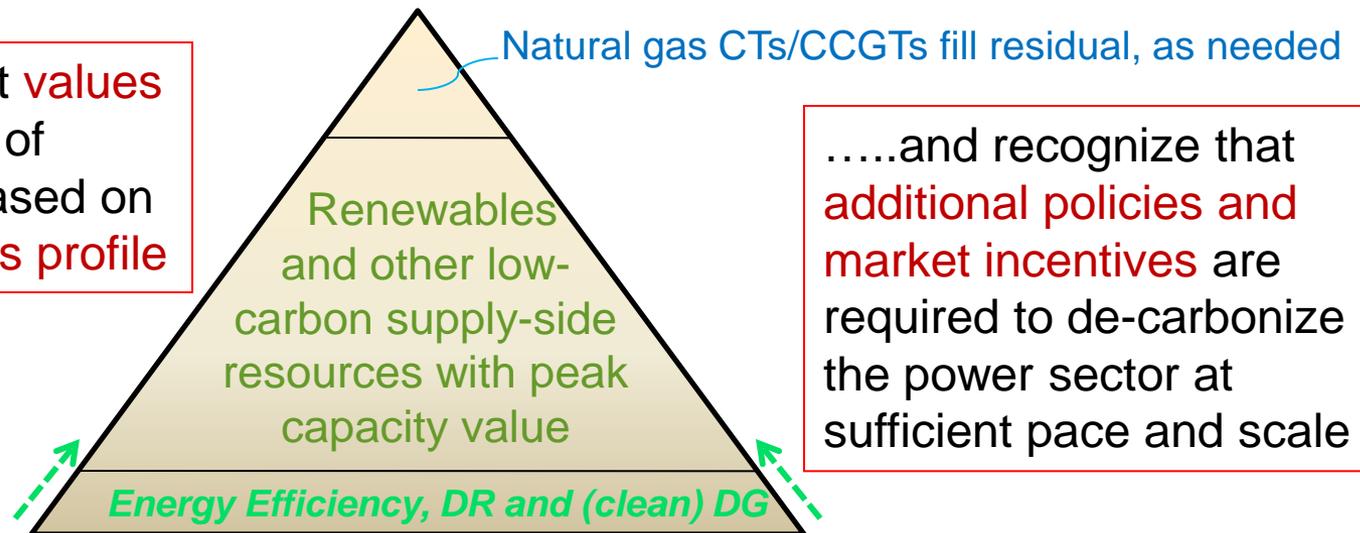
Current FCM Design Rewards This Mix of **New, Peak Capacity Resources**:



.....because the auction values “quantity” of committed capacity, based on bid price alone

(\*updates to existing nuclear facilities, no new-build)

A “Clean First” Framework Would Focus Capacity Payments on This Mix:



.....with an auction that values both quantity and mix of committed capacity, based on bid price and emissions profile

.....and recognize that additional policies and market incentives are required to de-carbonize the power sector at sufficient pace and scale



# Clean First: Aligning FCM Market Incentives With Climate Goals Will Require:

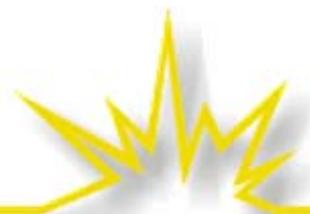
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## Strengthening What is Working in Concert Already:

- Refine market rules to **ensure that energy efficiency and other clean demand-side resources can fully compete** on an equal basis with supply-side resources

## Fixing What is Not Working by...?

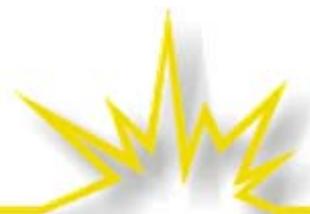
- Selecting auction winners based on **level of carbon emissions as well as bid price?**
- **Phasing out capacity payments to existing, high-emitting resources?**
- Making **capacity payments only to resources with low- or zero carbon emissions?**
- Establishing **auctions for separate tranches of resources by emissions level**
- Providing **premium capacity payments to low-carbon resources?**
- Allowing a **longer price commitment** or establishing **fixed capacity floor prices for low-carbon resources?**
- A combination of some of the above?



# And additional Market Drivers, Policies and Actions are Needed...

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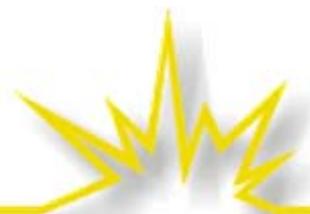
- **Sustained and aggressive energy efficiency policies and programs**
  - Strong efficiency building codes and equipment standards
  - Legally binding energy savings obligation on capable and non-conflicted entities in the market that can deliver
  - Stable public funding to leverage private investment through a system benefit charge or recycling of carbon auction proceeds to efficiency and other low carbon resources
  - Long-term financing options for consumers
- **Transmission access and cost allocation policies that give priority to clean generation development**
- **Regulations/performance standards to strengthen carbon price signals**, in order to prevent lock-in of high-carbon emitting resources in the energy mix
- ....**among others**, that will work in concert in the emerging regulatory and market landscape **to ensure resource adequacy, energy security and full decarbonization of the power sector by 2050, at reasonable costs to consumers.**



# Some Caveats About FCMs.... Are They Right for You?

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- Introducing a centralized, administrative FCM may not be the “right” move for every country or region without thinking through the following:
  - FCMs require putting in place **regional system operators** with clear **regulatory authority**/mandates, with **obligations on all resources and LSEs in the region**.
  - **Market liquidity** and **concentration** needs to be considered
  - In practice, FCMs currently act like spot capacity markets (with price-only competition, volatile capacity prices and short-term price commitments):
    - **Is it possible to effectively re-craft them** to mimic a capacity expansion plan that considers increasingly important non-price attributes?
    - **What alternatives might be considered** (e.g., competitive tenders for low carbon resources with peak capacity value? Enhanced demand-side bidding in bilateral capacity markets?)
  - Will **dynamic pricing** and **price-responsive demand** ultimately **reduce or eliminate the need for administrative capacity mechanisms**?



# Summary

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- *An Overlay of “Clean First” Considerations Can Better Align Power Sector Regulation with Climate (and other Environmental) Goals*
- Experience with Forward Capacity Markets (FCMs) illustrates what happens when power sector regulation lacks a “Clean First” perspective:
  - FCMs and other capacity mechanisms designed with a focus on *balancing peak demand and supply quantities* through *price competition alone* will work *at cross purposes with other policy objectives* that require a strong focus on getting the *mix* of resources “right” (e.g., security of supply and reduction of carbon emissions)
  - *In a carbon constrained world, capacity markets need to be discriminating—rather than “carbon neutral”* with respect to the resources that get paid capacity payments for being available to meet peak loads on the system.
  - *When designed through a “Clean First” filter*, market incentives for capacity can be focused on clean resources, while meeting reliability requirements at reasonable costs.
- Even when designed to work in concert with carbon reduction goals, *capacity markets are not a “silver bullet”* for creating a market and regulatory landscape that will drive de-carbonization of the power sector at the scale and pace required
- *Additional policies at the regional, national, and local level will be needed to achieve energy security and carbon reduction goals*



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“You can’t solve a problem with  
the same thinking that created it”

~Albert Einstein



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“You can’t solve a problem with the same regulations that created it”

~ Meg Gottstein



# For More Information

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Meg Gottstein, Principal  
The Regulatory Assistance Project

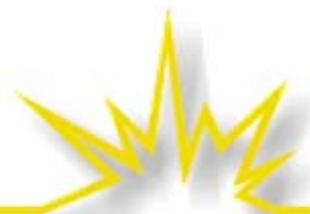
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***“The Role of Forward Capacity Markets in Increasing Demand-Side and Other Low Carbon Resources: Experience and Prospects” (May 2010), available at [www.raponline.org](http://www.raponline.org) and as part of the 2050 Roadmap Project: [http://www.roadmap2050.eu/RAP\\_ForwardCapacityMarkets.pdf](http://www.roadmap2050.eu/RAP_ForwardCapacityMarkets.pdf)***



# Additional Slides

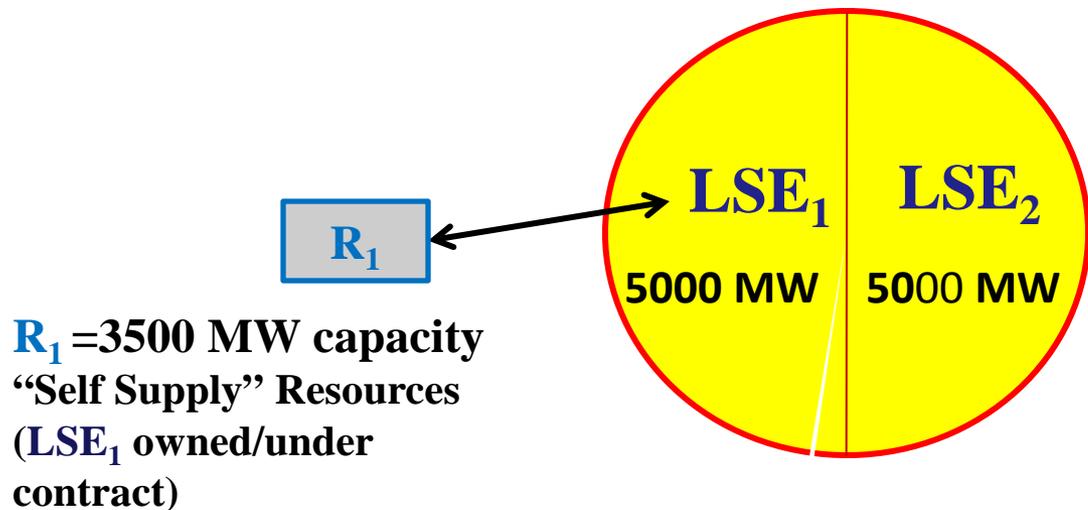
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- Illustration of “how FCMs work”
- Additional detail on auction results (demand-side, wind, supply-side additions, PJM zonal prices)
- Additional narrative on how FCMs work
- ISO-NE auction--graphic
- PJM Auction—graphic
- How long-term resource planning might fit into a FCM framework
- Load curve graphs—illustrating how EE and demand response reduce peak loads
- North America Electric Transmission Regions
- Misc text slides
- Considering Future (2050) Resource Mix and Demand-Supply Balancing Requirements (EU 2050 Roadmap Results)

## System Operator (SO) Plans “Forward” for the Region

2012 Projection of Peak Demand = 10,000 MW (incl. reserves)

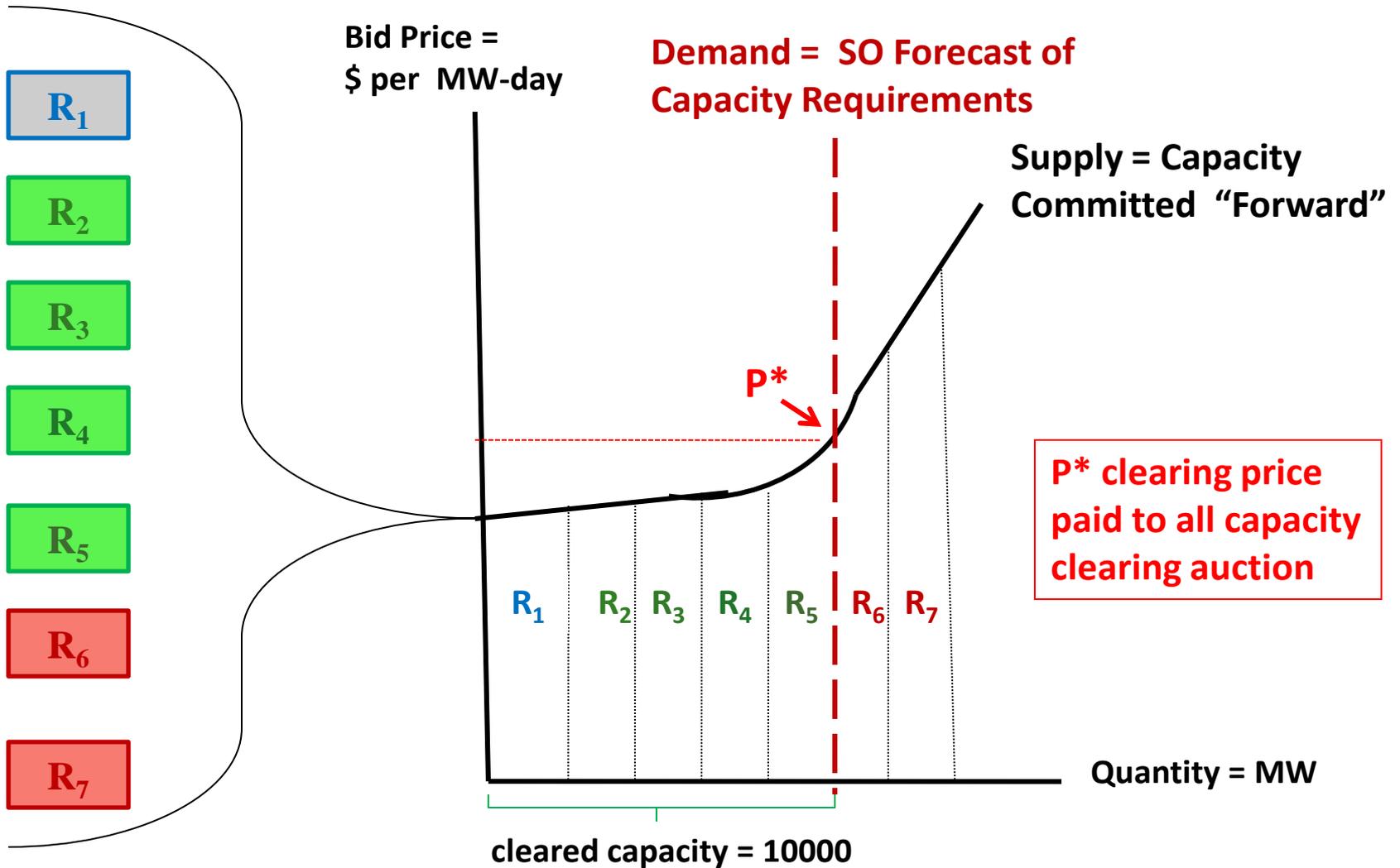
Each “Load Serving Entity” (LSE) \* is obligated for its 50% share



SO purchases capacity in 2012 at the 2009 auction clearing price

\* LSE can be regulated utility or competitive retail supplier

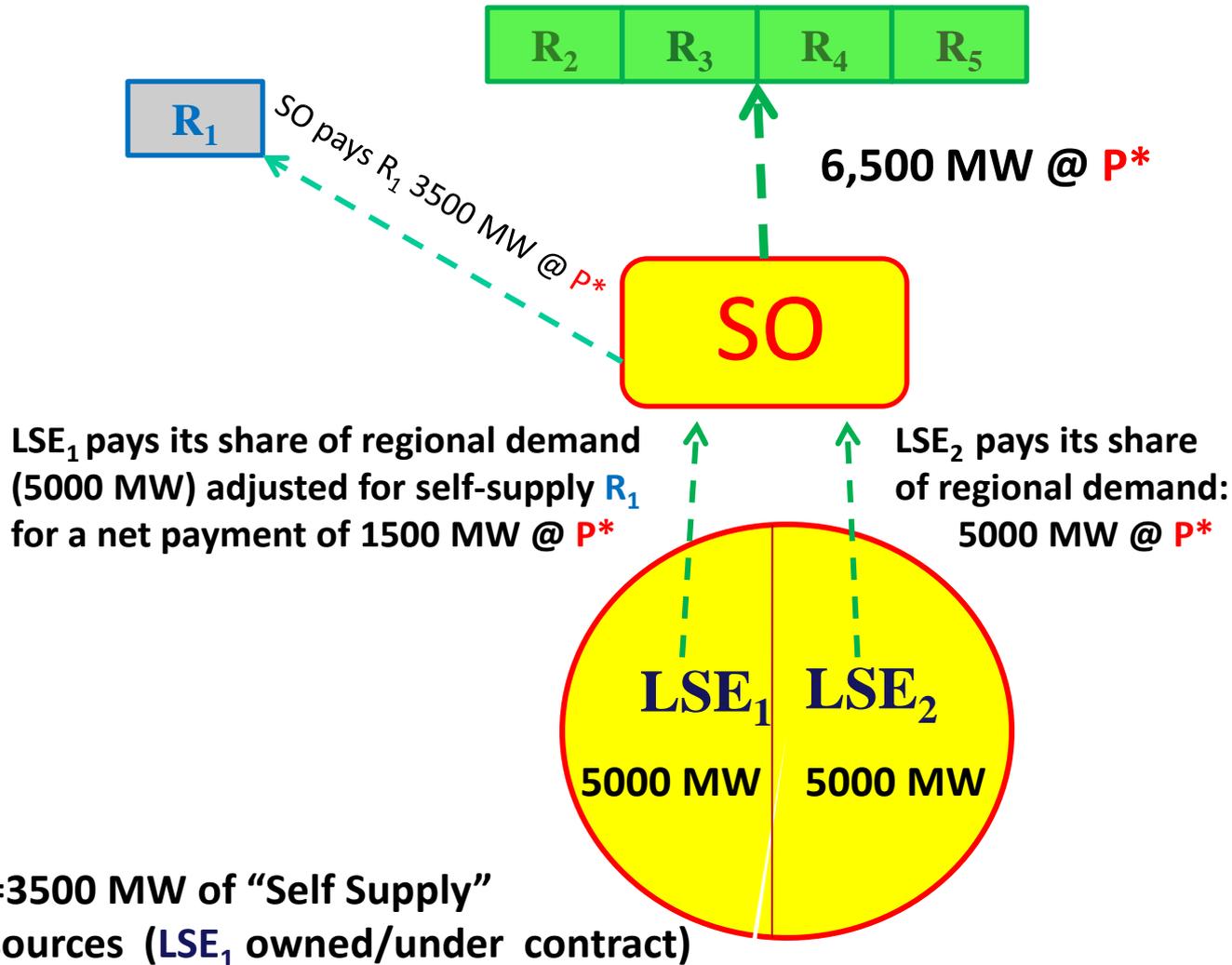
# The Regional Capacity Auction (3 years “Forward”)



R<sub>1</sub>-R<sub>7</sub> = Capacity offered by Supply-Side (New built, Existing, Uprates) and Demand-Side (Energy Efficiency, Demand Response, Distrib. Gen); Self-supply (R<sub>1</sub>) bids in a “zero” price; New Resources set clearing price

# System Operator Pays Cleared Resources at $P^*$ and Bills LSEs

(Note: Self-Supply capacity is a “wash”)



In 2012:

Total regional peak demand of 10,000 MW

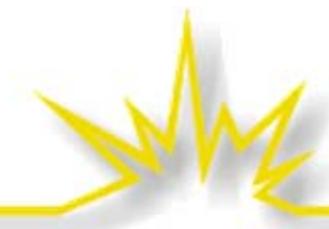
Supplied by

$R_1 + R_2 + R_3 + R_4 + R_5$ . LSE<sub>1</sub>

and LSE<sub>2</sub> are

each

responsible for 50% of regional peak demand.



# Demand-Side Resources in the 2012/2013 Auctions

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## PJM

- Demand-Side Resources Cleared:  
**7,616.2 MW**
  - Demand Response (including on-site, distributed generation):  
7,047.3 MW
  - Energy Efficiency: 568.9 MW
- Out of 136,143.6 MW Total Cleared

## ISO-NE

- Demand-Side Resources Cleared:  
**2,898 MW**
  - Demand Response: 1,206 MW
  - Energy Efficiency: 975 MW
  - Distributed Generation-Fossil Fuel: 86 MW
  - Distributed Generation-Renewable Energy: 0.7 MW
  - Real-Time Emergency Generation: 630 MW\*
- Out of 36,996 MW Total Cleared

\*Real-Time Emergency Generation in ISO-NE is limited to 600 MW. Payments to generators are reduced on a pro-rated basis if a higher amount clears.



# Wind Resources in the Capacity Auctions

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- Capacity markets are concerned about resources available on-peak hours – i.e., their on-peak capacity factor.
- Wind is primarily an energy resource, not a capacity resource.
- Treatment of Wind in PJM Capacity Market
  - Deemed 13% on-peak capacity factor: For every 100 MW of wind resources, 13 MW are eligible to meet capacity requirements.
  - 323.4 MW cleared the most recent auction – 95% of amount offered\*
  - Represents a large nameplate rating – 2,488 MW
- Treatment of Wind in ISO-NE Capacity Market
  - Use data to demonstrate winter/summer qualified capacity (Not deemed)
  - Capacity factor adjusted over time based on performance during specified hours
  - 166 MW cleared the most recent auction\*\*
  - Nameplate rating is perhaps an order of magnitude larger

\*See PJM, “2012/2013 RPM Base Residual Auction Results,” at <http://www.pjm.com/~media/markets-ops/rpm/rpm-auction-info/2012-13-base-residual-auction-report-document-pdf.ashx>

\*\* Compiled from auction results at

[http://www.iso-ne.com/markets/othrmkts\\_data/fcm/cal\\_results/ccp13/fca13/index.html](http://www.iso-ne.com/markets/othrmkts_data/fcm/cal_results/ccp13/fca13/index.html)



# Supply-Side Additions in PJM Capacity Market

	Delivery Year	CT/GT	Combined Cycle	Diesel	Hydro	Steam (Coal)	Nuclear	Solar	Wind	Total
<b>New Capacity Units</b>	2007/2008			18.7	0.3					19.0
	2008/2009			27.0					66.1	93.1
	2009/2010	399.5		23.8		53.0				476.3
	2010/2011	283.3	580.0	23.0					141.4	1027.7
	2011/2012	416.4	1135.0			704.8		1.1	75.2	2332.5
	2012/2013	403.8	585.0	7.8		36.3			75.1	1108.0
<b>Capacity From Reactivated Units</b>	2007/2008					47.0				47.0
	2008/2009					131.0				131.0
	2009/2010									0
	2010/2011	160.0		10.7						170.7
	2011/2012	80.0				101.0				181.0
	2012/2013									0

# Supply-Side Additions in PJM Capacity Market (cont.)

Upgrades to Existing Capacity Resources	Delivery Year	CT/GT	Combined Cycle	Diesel	Hydro	Steam (Coal)	Nuclear	Solar	Wind	Total
	2007/2008	114.5		13.9	80.0	235.6	92.0			536.0
	2008/2009	108.2	34.0	18.0	105.5	196.0	38.4			500.1
	2009/2010	152.2	206.0		162.5	61.4	197.4		16.5	796.0
	2010/2011	117.3	163.0		48.0	89.2	160.3			577.8
	2011/2012	369.2	148.6	57.4		186.8	292.1		8.7	1062.8
	2012/2013	231.2	164.3	14.2		193.0	126.0		56.8	785.5
<b>Total - All Additions</b>		<b>2835.6</b>	<b>3015.9</b>	<b>214.5</b>	<b>396.3</b>	<b>2035.1</b>	<b>906.2</b>	<b>1.1</b>	<b>439.8</b>	<b>9844.5</b>

**Offered versus Cleared Capacity in PJM Auctions--By Resource Type (incremental and existing generation units)**

Delivery Year	Data	Coal	Distillate Oil (No.2)	Gas	Kerosene	Nuclear	Other - Gas	Other - Liquid
2007/2008	Offered UCAP	41,882	4,168	39,746	1,202	28,228	231	41
	Cleared UCAP	41,600	4,168	39,225	1,197	28,076	201	41
2008/2009	Offered UCAP	42,638	4,339	38,794	1,199	28,334	251	41
	Cleared UCAP	41,564	4,304	38,301	1,147	28,089	222	41
2009/2010	Offered UCAP	43,114	4,211	39,250	1,312	28,431	268	40
	Cleared UCAP	42,524	4,192	38,781	1,310	28,278	239	40
2010/2011	Offered UCAP	42,939	4,366	38,597	1,382	28,427	302	40
	Cleared UCAP	42,869	4,278	38,193	1,376	28,240	272	40
2011/2012	Offered UCAP	44,448	4,502	40,515	1,382	28,731	302	40
	Cleared UCAP	42,423	4,361	39,489	1,324	28,505	271	40
2012/2013	Offered UCAP	43,777	4,295	40,766	1,255	28,655	299	40
	Cleared UCAP	42,300	4,205	36,868	1,255	28,655	270	40

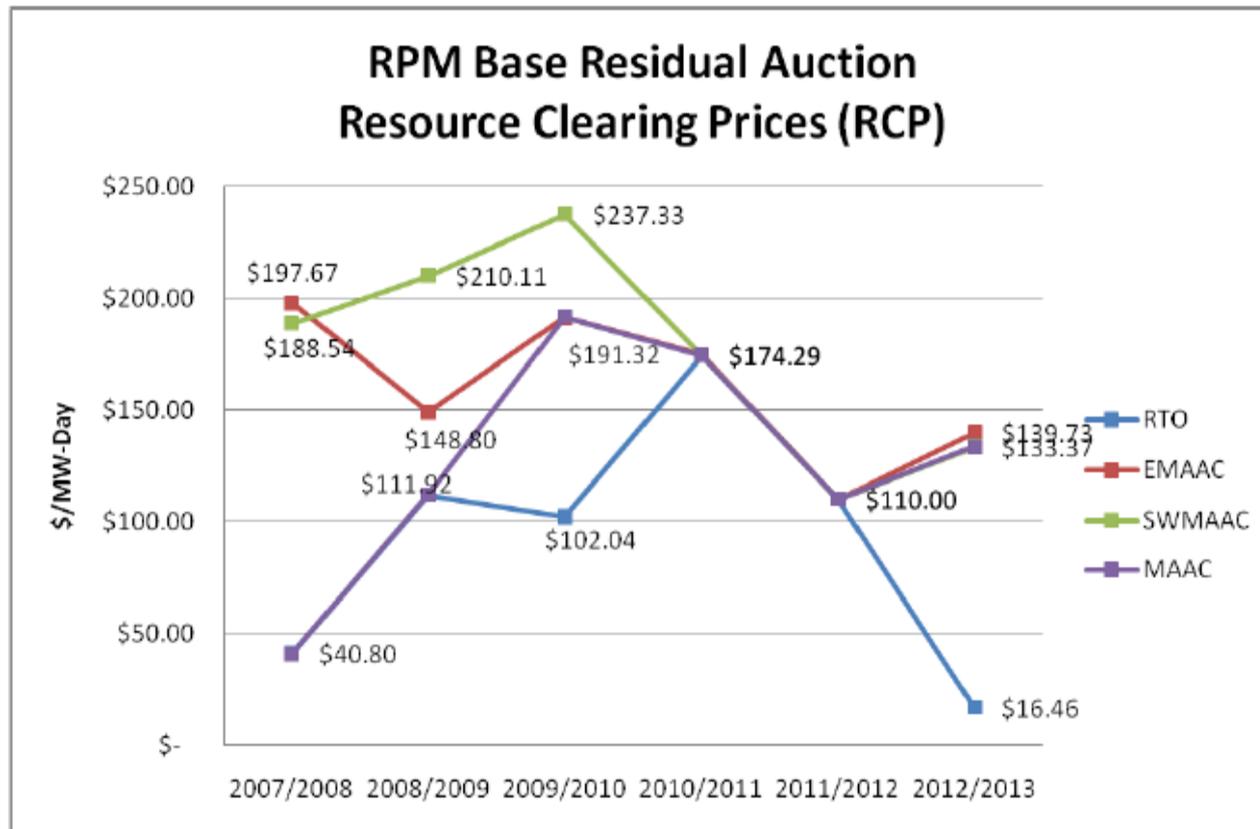
Delivery Year	Data	Oil	Other - Solid	Solar	Water (Hydro)	Wood (Biomass)	Wind	Demand Response	Energy Efficiency	Grand Total
2007/2008	Offered UCAP	8,277	515		6,245	151	29	128		130,844
	Cleared UCAP	7,842	515		6,237	151	29	128		129,409
2008/2009	Offered UCAP	8,339	536		6,493	106	95	716		131,881
	Cleared UCAP	8,287	536		6,373	105	95	536		129,598
2009/2010	Offered UCAP	8,277	536		6,960	106	111	937		133,551
	Cleared UCAP	8,277	536		6,947	106	111	893		132,232
2010/2011	Offered UCAP	8,277	514		6,950	104	227	968		133,093
	Cleared UCAP	8,192	514		6,945	104	227	939		132,190
2011/2012	Offered UCAP	8,333	514	1	6,940	104	257	1,652		137,720
	Cleared UCAP	6,662	514	1	6,907	104	257	1,365		132,222
2012/2013	Offered UCAP	7,809	525	1	6,962	149	340	9,848	653	145,373
	Cleared UCAP	6,977	525	1	6,959	149	323	7,047	569	136,144

Source: PJM, website table

Note: Energy efficiency was first eligible to bid in PJM's auction for the 2012/2013 delivery year



## 2012/2013 RPM Base Residual Auction Results



\* RTO and MAAC Resource Clearing Prices for the 2007/2008, 2008/2009, 2010/2011, and 2011/2012 BRA are equal.

\*\*EMMAC and MAAC Resource Clearing Prices for the 2009/2010, and 2010/2011, and 2011/2012 BRA are equal.

\*\*SWMAAC and MAAC Resource Clearing Prices for the 2010/2011, 2011/2012, and 2012/13 BRA are equal.

Table 2 contains a summary of the offer and resultant data in the RTO for each cleared Base Residual Auction from 2008/09 through the 2012/2013 Delivery Years. The summary includes all resources located in the RTO (including all LDAs within the RTO) and notes the capacity located outside the PJM footprint that was offered into the auction.



# FCM Responsibilities and Obligations

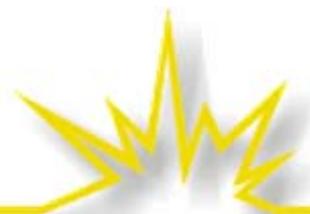
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## ➤ **Regional System Operator**

- Forecasts loads, determines regional “forward” capacity need
- Runs the auctions to establish price for capacity for delivery year
  - \$/MW-day or \$kW-month
- Procures any “residual” capacity resources needed for region and bills the **load-serving entities (LSEs)** their pro rata share of costs

## ➤ **LSEs**—both regulated utilities and retail electricity suppliers:

- Must have sufficient capacity to meet their own customer’s peak loads (plus reserves) on a “forward” basis:
  - System operator purchases capacity on LSE’s behalf at auction clearing prices (and sends “the bill”), or
  - LSE can “self-supply”—through bilateral contracts or LSE-owned resources
    - Requires system operator approval and subject to penalties if self-supply capacity doesn’t materialize
- Must “pay the piper” on a pro rata basis, for residual capacity<sub>37</sub> purchases by system operator



# FCM Responsibilities and Obligations (cont.)

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## ➤ Demand- and supply-side resources:

- All existing generating capacity as well as new demand or supply-side resources must “offer” their available, forward capacity commitments into the auction \*
  - This establishes the “quantity” of capacity offerings into the auction (that builds the auction “supply curve”)
- They must be pre-qualified by system operator
  - Demonstrate they can meet capacity commitment for delivery year (available to reduce peak loads reliably)
  - Qualification deposit, financial assurances to ensure commercial operation; extensive M&V for energy efficiency resources
- If they “clear” the auction they must perform
  - Penalties for performance failures

\*with some exceptions

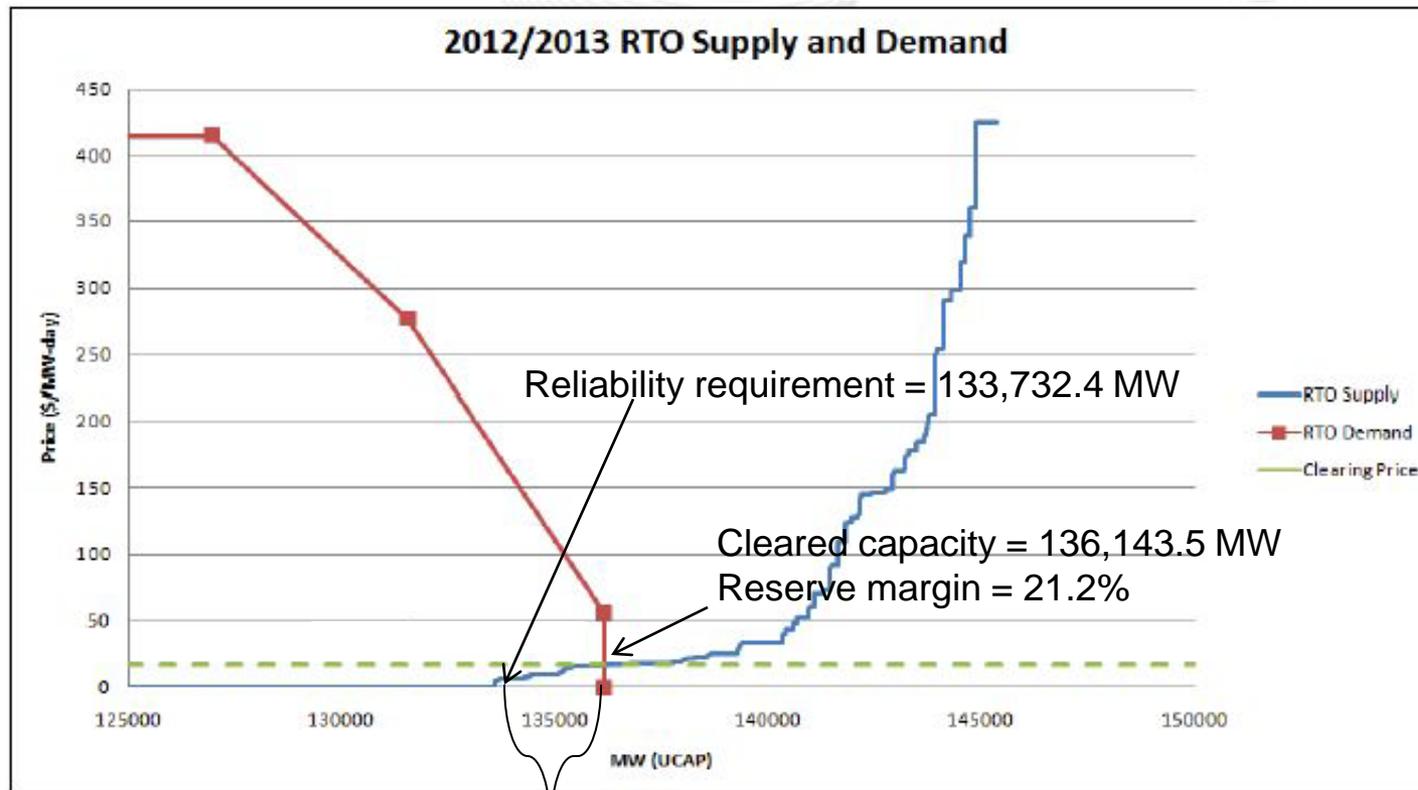


# ISO-NE's Forward Capacity Auction

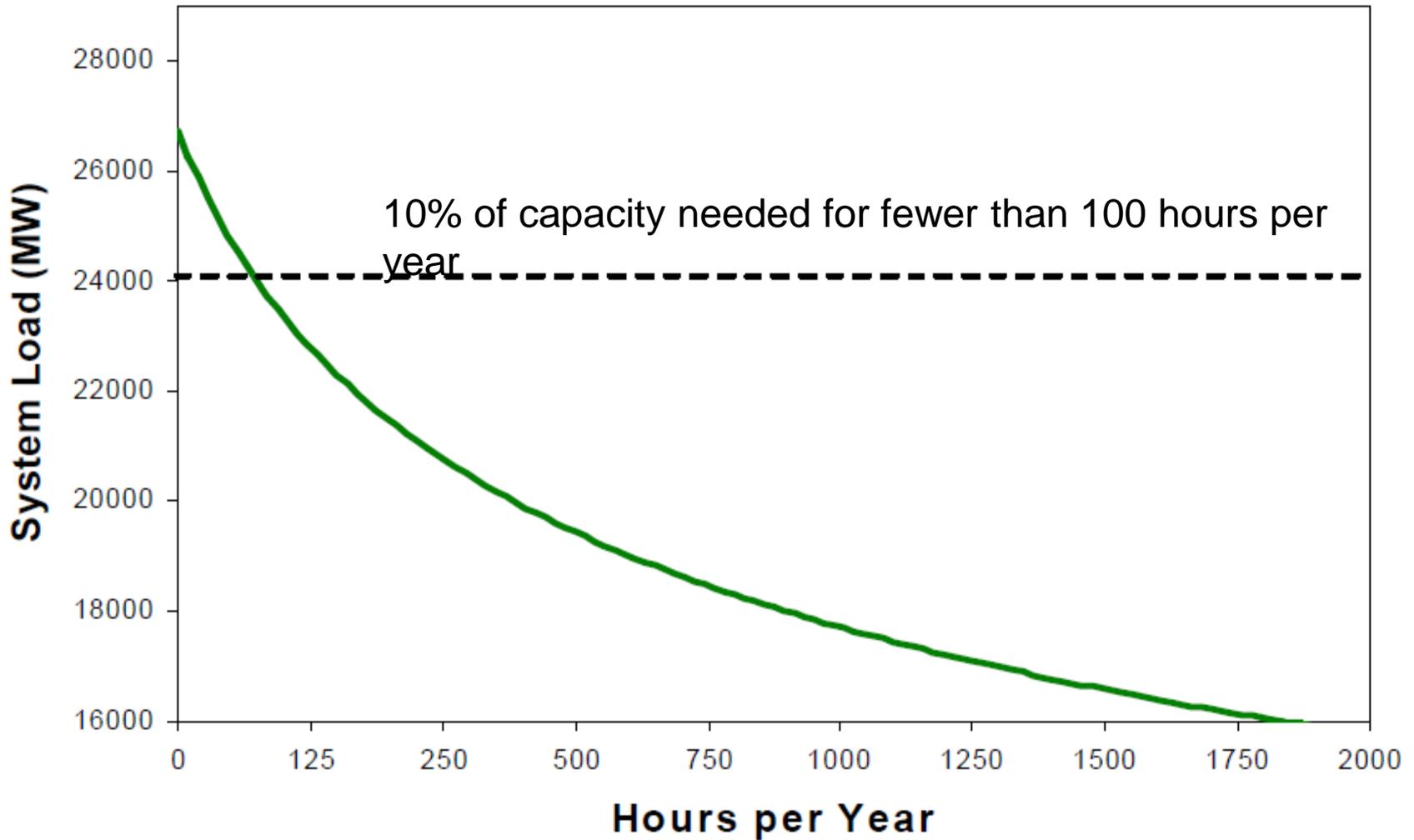
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- Single quantity (MW) is put out to bid
- Descending clock auction
  - Successive bidding rounds until no excess capacity is offered or the administratively set floor price is reached
- 2012/2013 auction
  - Seven bidding rounds over two days
  - Capacity requirement (set by ISO-NE) - 31,965 MW
  - Capacity cleared in the auction - 36,996 MW
  - Excess capacity - 4,649 MW
  - Clearing price - \$2.95/kW-month (floor price)

# PJM's Auction for the 2012/2013 Delivery Year



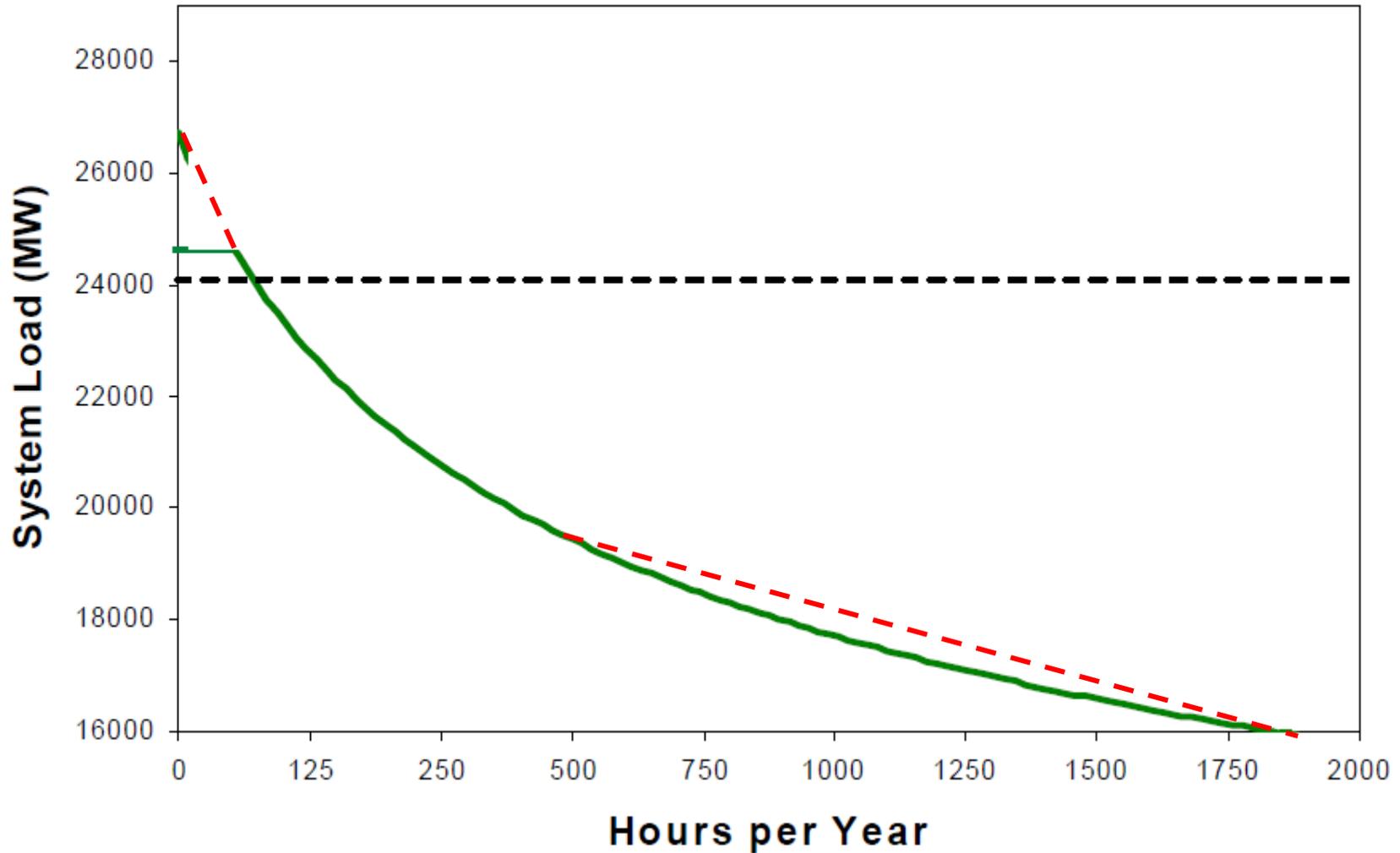
# Load Duration Curve: Level of System Load (MW) over # of Hours per Year



For New England Region: 25% population, 125% of land area, 40% of supply capacity (MW)  
 of UK China India European Union Latin America United States

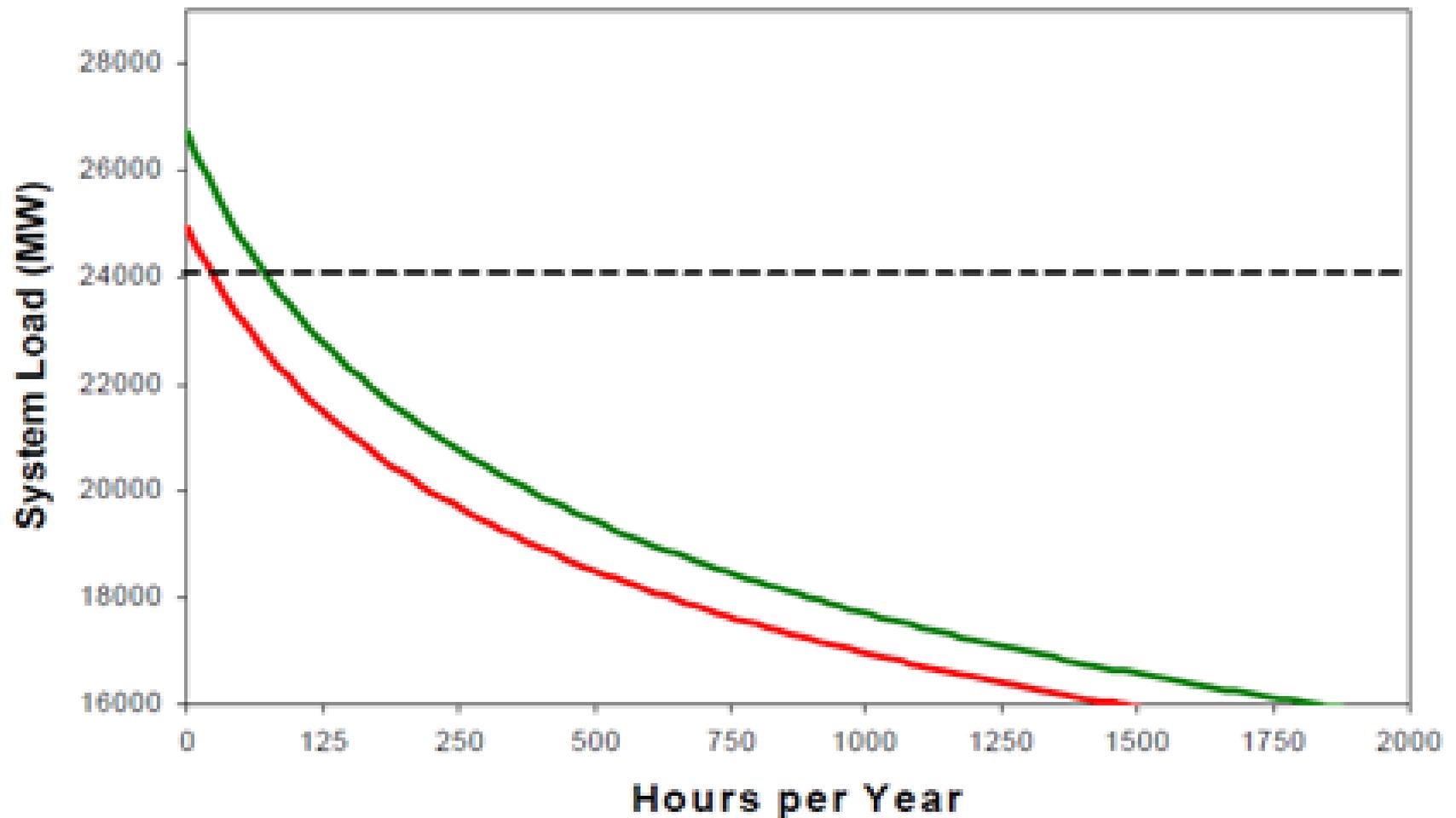
Source: Vermont Energy Investment Corporation: "Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", ECEEE 2009 Summer Study Proceedings

# Demand-Response can reduce Peak Load (but also shift load to other hours)



Source: Vermont Energy Investment Corporation: "Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", ECEEE 2009 Summer Study Proceedings

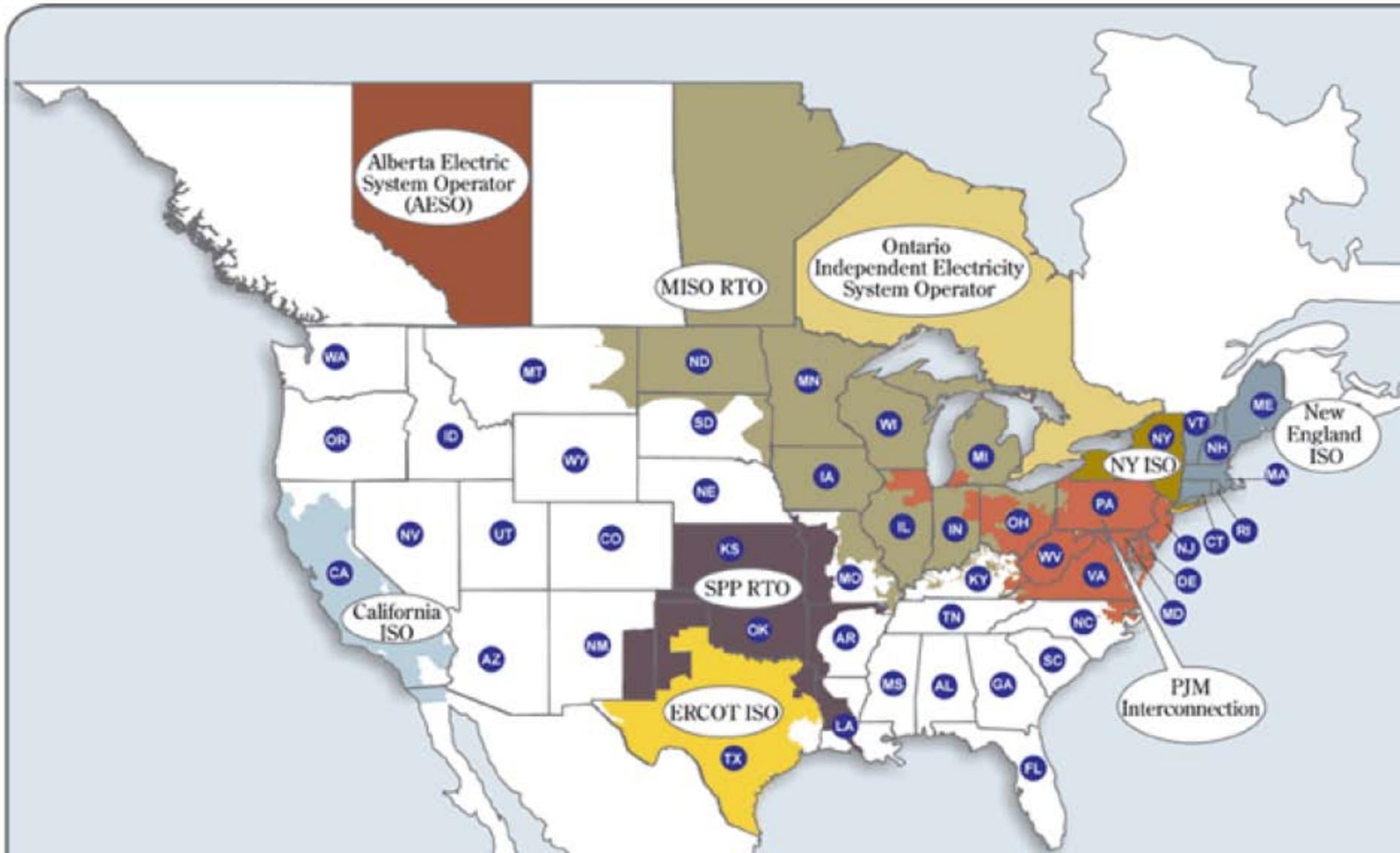
## Energy Efficiency Reduces Demand for All Hours, Including Peak



Source: Vermont Energy Investment Corporation: "Energy Efficiency as a Resource in the ISO New England Forward Capacity Market", EC&EE 2009 Summer Study Proceedings

# North American Electric Transmission Regions

VERMONT ENERGY INVESTMENT CORPORATION

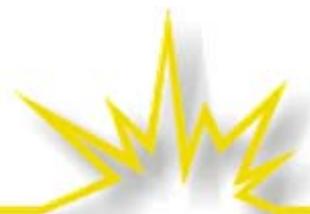




# Can FCMs help “set the stage” for a power system of the future?

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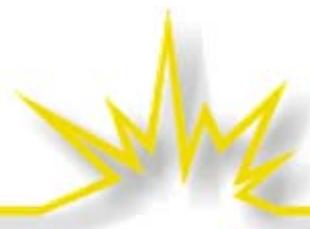
- System operators become comfortable and proficient at **balancing supply and demand from two directions**—which will be needed more and more in the future (smart meters, more variable renewables to balance with demand response and storage, etc.)
- Performance to date demonstrates that reducing customer demand for electricity is **functionally equivalent to producing power from generating resources** for keeping supply and demand in balance
- Provides valuable **experience** for **verifying performance** of demand-side resources and in **assessing the firm capacity value** of variable supply-side resources (e.g., wind)



# So if FCMs Become Part of the Evolving Regulatory Landscape...

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- *Current FCM design must be improved* to work in concert—rather than at cross purposes—with carbon reduction goals, *but keep in mind that:*
  - FCM market incentives (capacity payments) are only one factor driving the mix of resources and carbon footprint of the power sector—and *are not a “silver bullet”*
  - Policies and market rules that affect the *mix of resources meeting system energy requirements are key drivers*
  - Policies and regulations that affect *access, location and cost recovery for transmission and distribution facilities are key drivers as well*
- *FCMs are one tool, but a “toolbox” is needed*—market rules, policies and additional actions designed to work in concert to decarbonize the power sector



# How Do FCMs Fit With Long-Term Resource Planning?

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- Capacity markets focus on quantity and timing, not resource mix
- LSEs can develop long-term plans to determine the best mix of resources considering projected cost, risks and uncertainties
- LSEs can sign bilateral contracts (for supply- or demand-side resources) for various terms
  - To limit their exposure to high auction prices
  - To meet energy efficiency, demand response, renewable resource, carbon and other state goals
  - Can enter them into the auction as “self-supplied” resources
- LSE-owned generating units also can bid as self-supply



# Policy Makers Need To Consider, and Anticipate....

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What Will the Future Resource Mix and Demand-Supply Balancing Requirements Need to be to Meet the Climate Change Challenge?

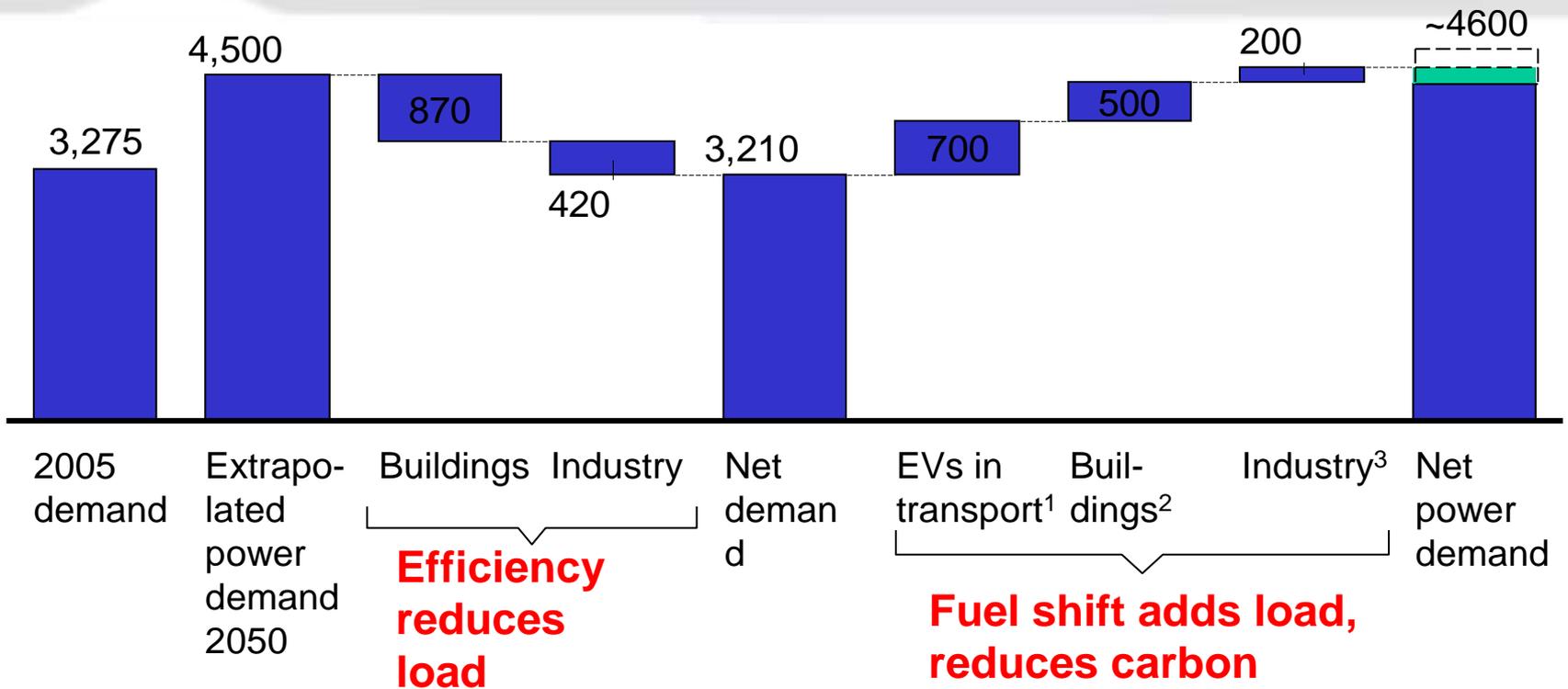
“2050 Roadmap Study” Results

[www.2050roadmap.eu](http://www.2050roadmap.eu)

European Climate Foundation Results

# Deep efficiency, and low-carbon generation needed to displace historic fossil gen and supply new electric uses (transport and heat)

## EU example -- net power demand in 2050 (TWh/year)

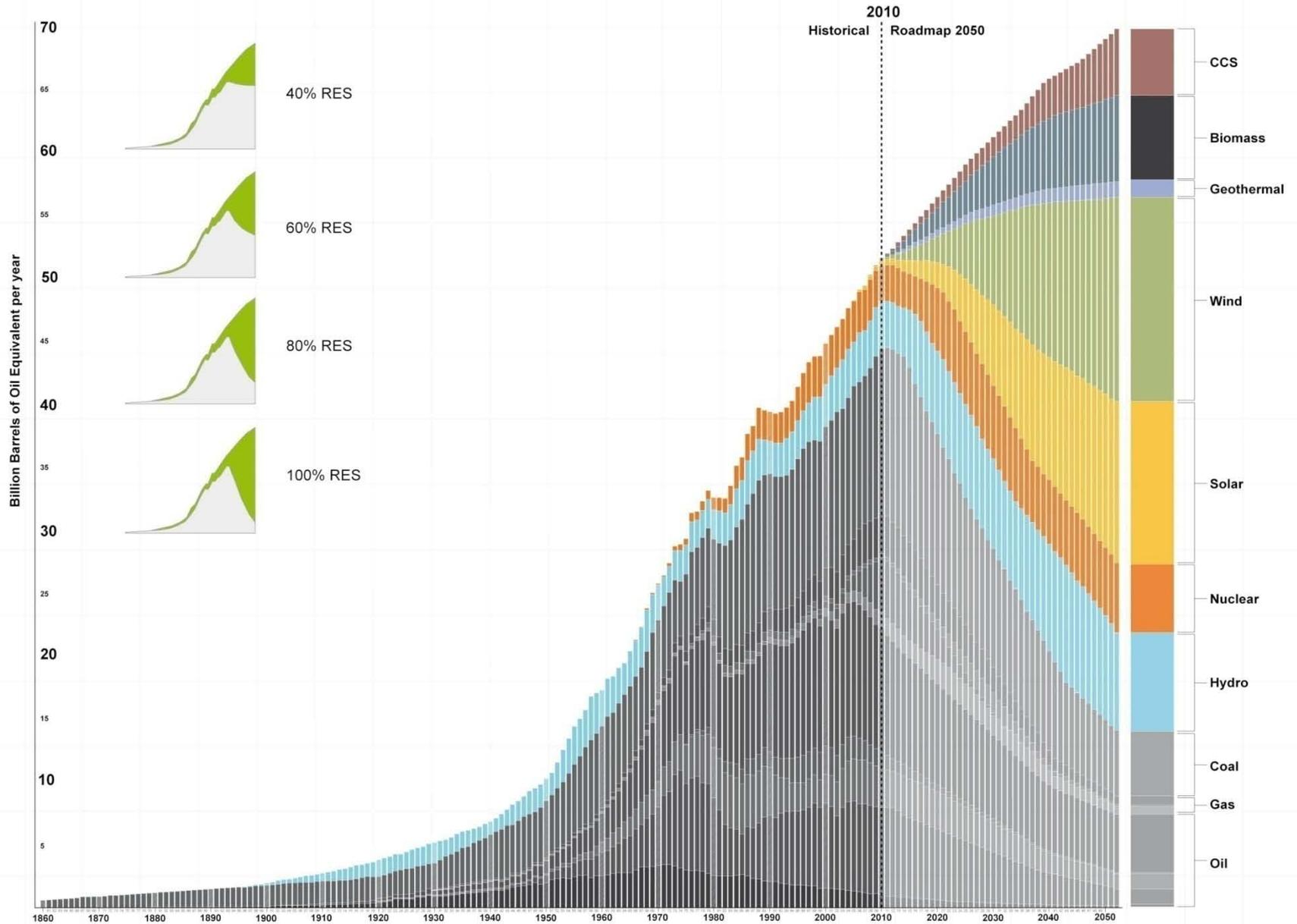


1 Assumption: electrification of 100% LDVs and MDVs (partially plug-in hybrids)

2 Assumption: 95% of remaining primary energy demand converted to electricity usage in Buildings for heating/cooling from heat pumps; assumed to be 2.5 times as efficient as primary fuel usage; lower case: electric heat pumps assumed to be 4 times as efficient as primary fuel usage

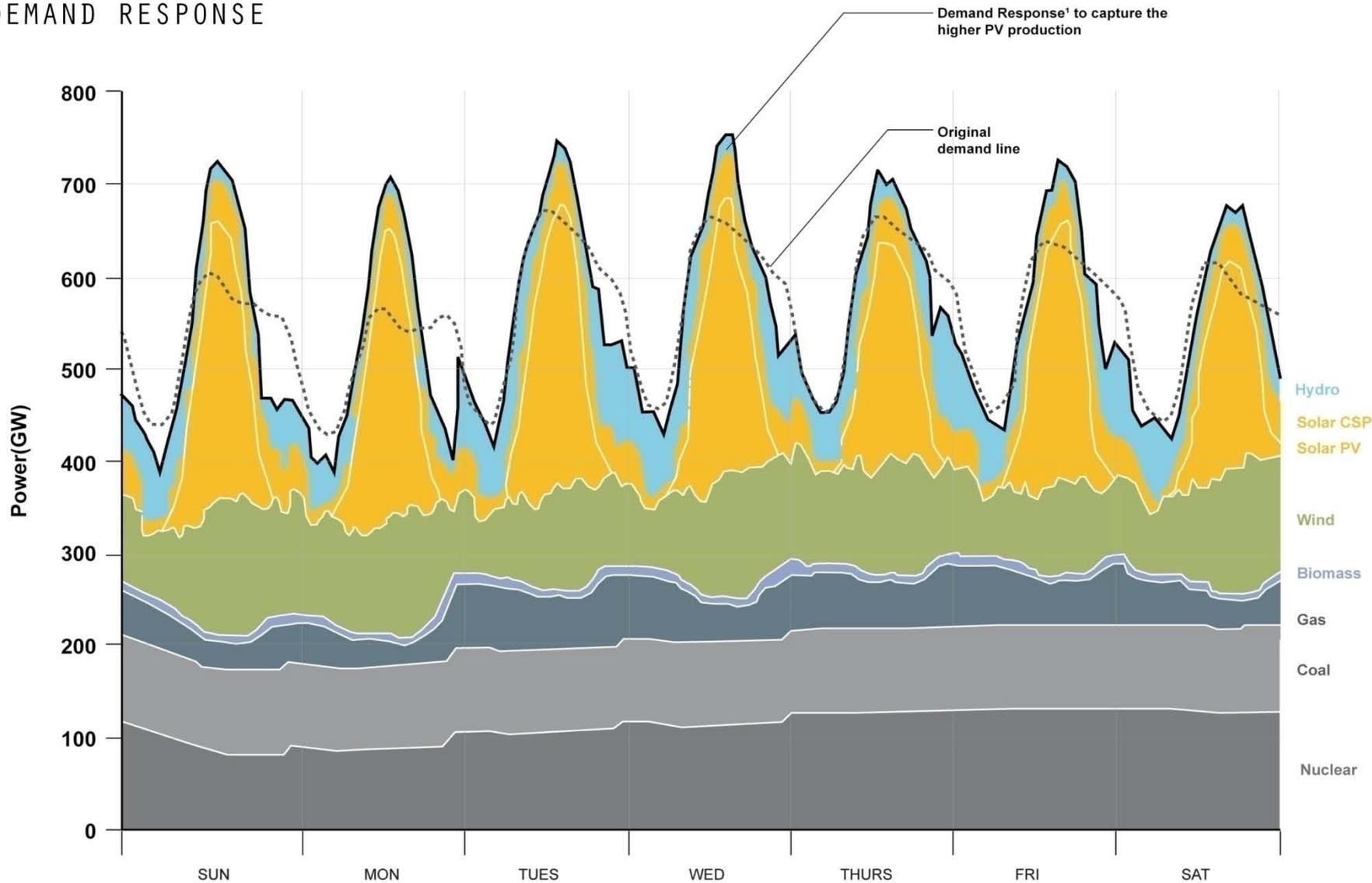
3 Assumption: 15% fuel switch of remaining primary energy demand converted to electricity in industry for heating from heat pumps; assumed to be 2.5 times as efficient as primary fuel usage; lower case: electric heat pumps assumed to be 4 times as efficient as primary fuel usage

# ENERGY SUPPLY IN 2050 (HIGH RES PATHWAY)



Sources: Roadmap 2050 Technical Analysis, McKinsey / Lynn Orr, Changing the World's Energy Systems, Stanford University Global Climate & Energy Project (after John Edwards, American Association of Petroleum Geologists); SRI Consulting / David Rutledge, Professor, California Institute of Technology 2009 / The Oil Age: World Oil Production 1859-2050, San Francisco, CA, Courtesy of San Francisco Informatics / Dr. Colin J. Campbell's oil depletion model, The Coming Oil Crisis, by Colin J. Campbell, Independent Publishers Group, April 1, 2004 / The Twenty First Century, The World's Endowment of Conventional Oil and Its Depletion, by Dr. Colin Campbell, 1996 / International Energy Agency

# DEMAND RESPONSE



**Daily Power Demand In A Week<sub>2</sub>**

<sup>1</sup> Demand response as used in this paper refers to changing a customer's electricity demand in response to dispatch instructions or price signals through communications technologies. In the Volume 1 analysis, it is assumed that any such changes retained the total energy consumed within the day, that is, moved or shifted demand rather than reduced total daily consumption<sup>2</sup>

- 1) The graph shows how the original demand line (dashed) is shifted to a higher level (black line) by DR to capture the higher PV production
- 2) 60% RES, 20% DR, Week 32 - Sunny week