RAP Energy solutions for a changing world

Reliability, Investment, Capacity and Capabilities

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Regulatory Assistance Project (RAP)

- A global, non-profit team of experts, predominantly former energy and air quality regulators
- Providing technical and policy assistance to regulators and government officials on energy and environmental issues.
- Since 1990 RAP have advised governments in more than 30 countries and 50+ provinces and states
- RAP now has major programs in the US, China, India and Europe.

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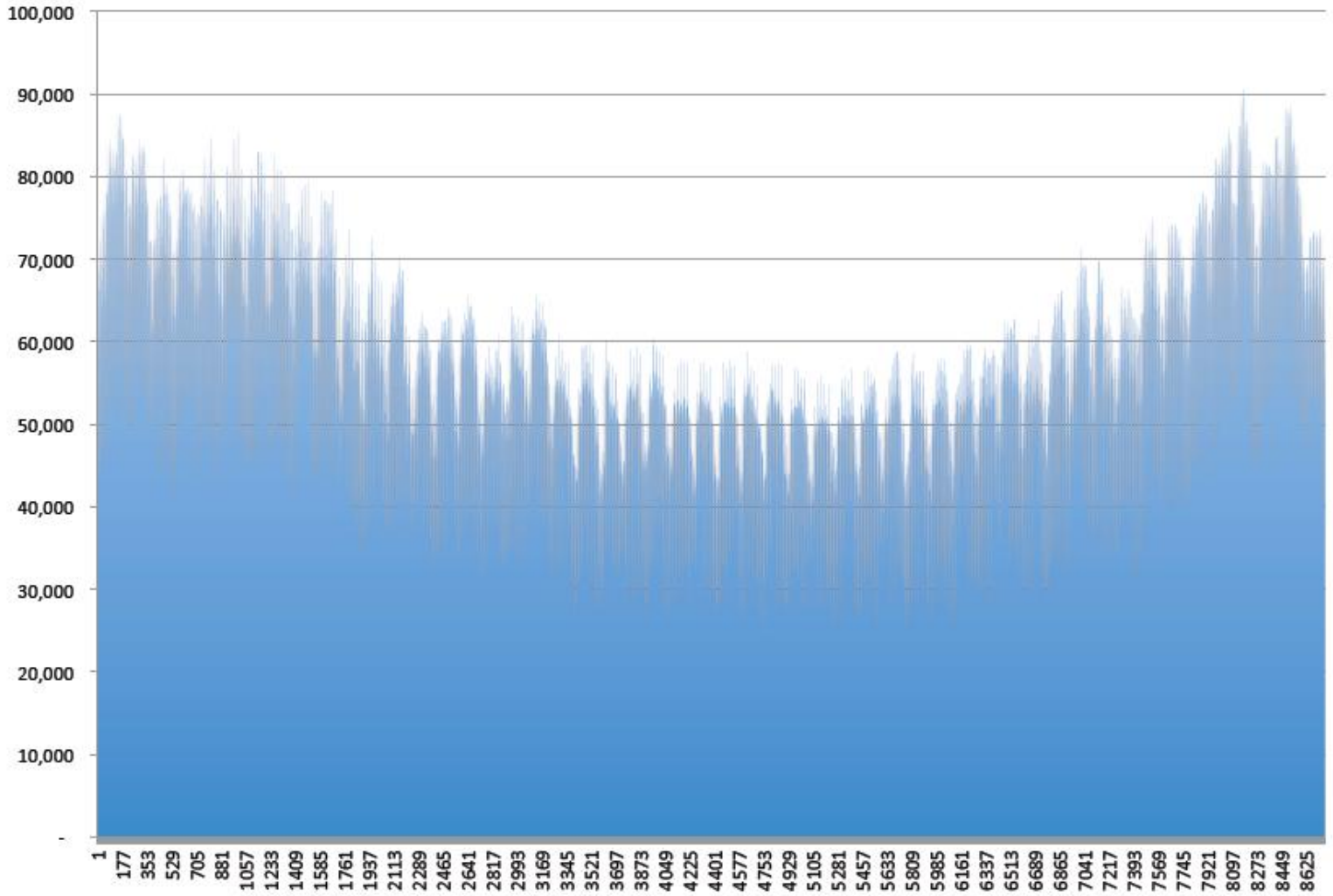
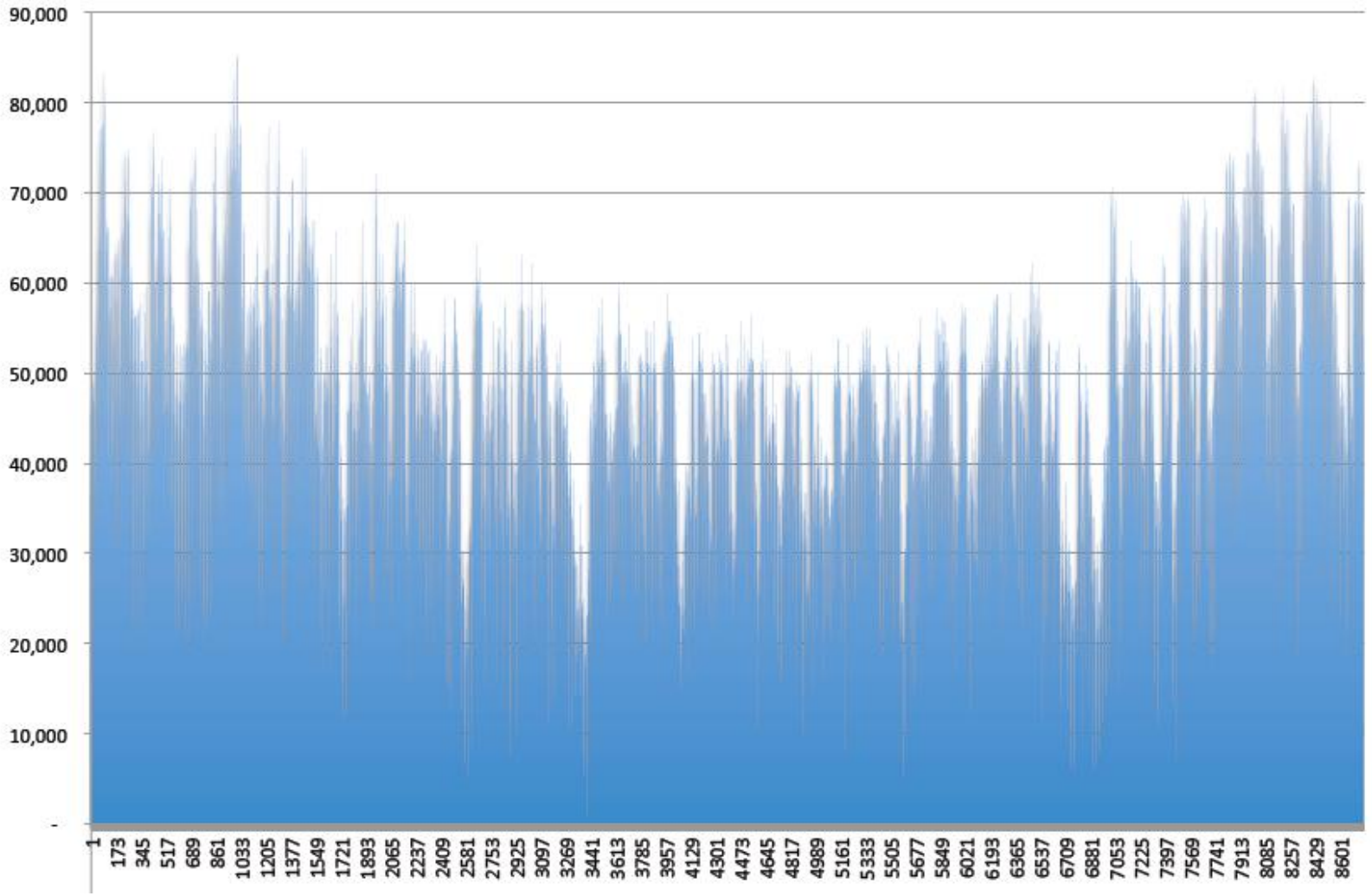
“UK South” 2030 (gross demand)

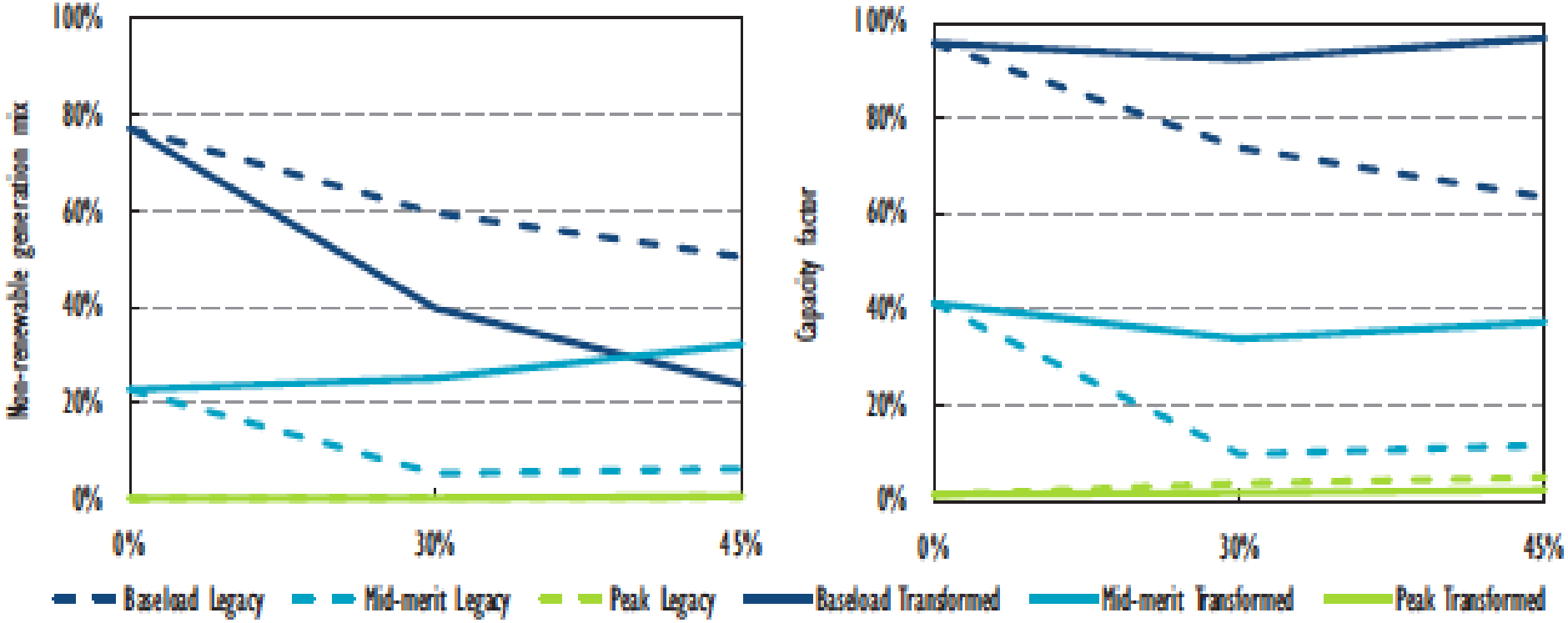


“UK South” 2030 (net demand)



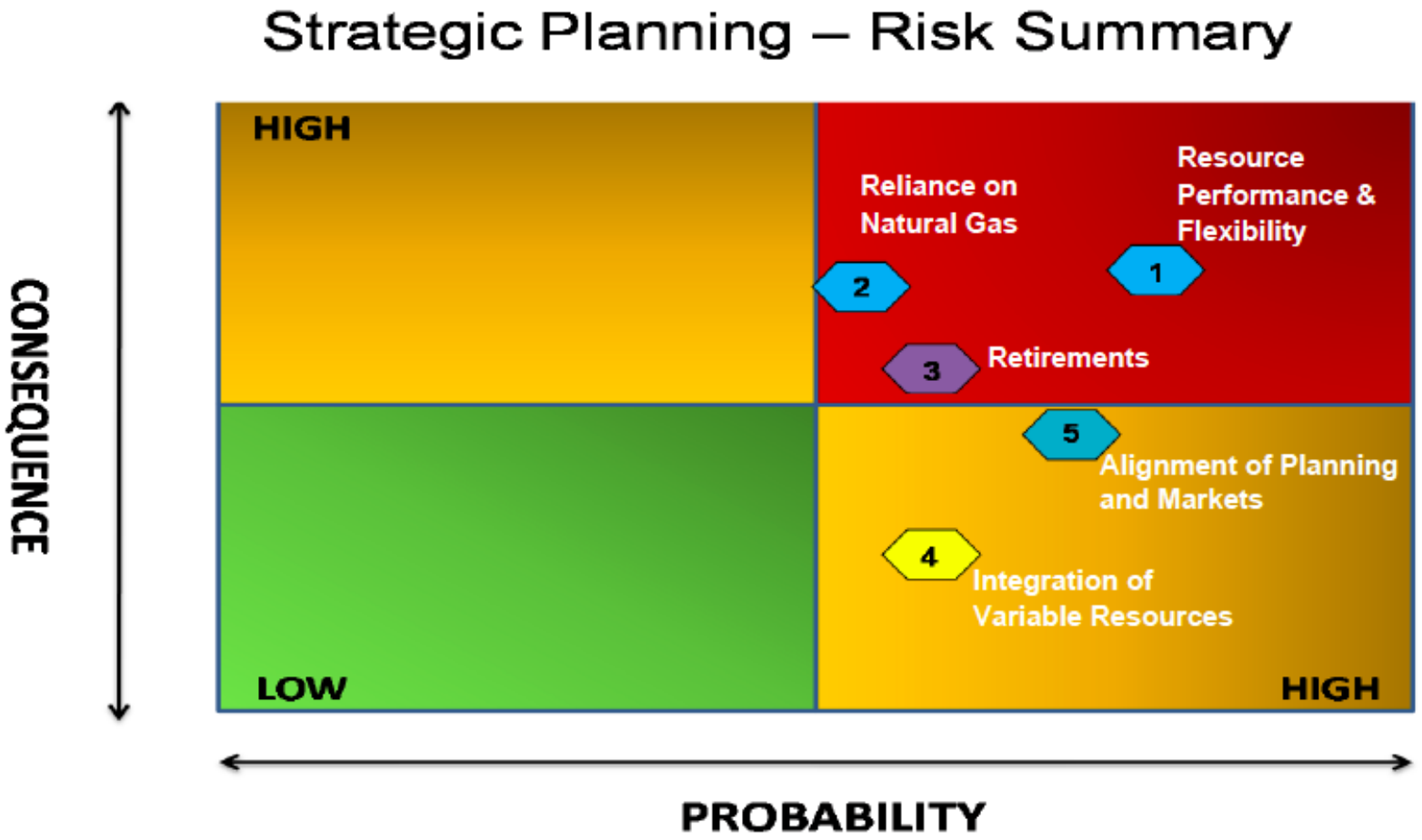
Capacity Only vs. Resource Capabilities

Figure 8.1 • Non-VRE generation mix and capacity factors under different IMRES scenarios



Source: International Energy Agency, *The Power of Transformation* (Mar 2014)

ISO-NE's Strategic Planning risk matrix (2012)



NOTES

1. Assessment regarding impact and likelihood reflects the collective assessment of ISO-NE senior staff, and are described in the pages that follow.
2. Color coding on category markers: BLUE: Risk is already evident or likely to materialize over the near-term (0-3 years); PURPLE Risk is likely to materialize over the mid-term (3-6 years); YELLOW Risk is likely to materialize over the long term (6-7 years)

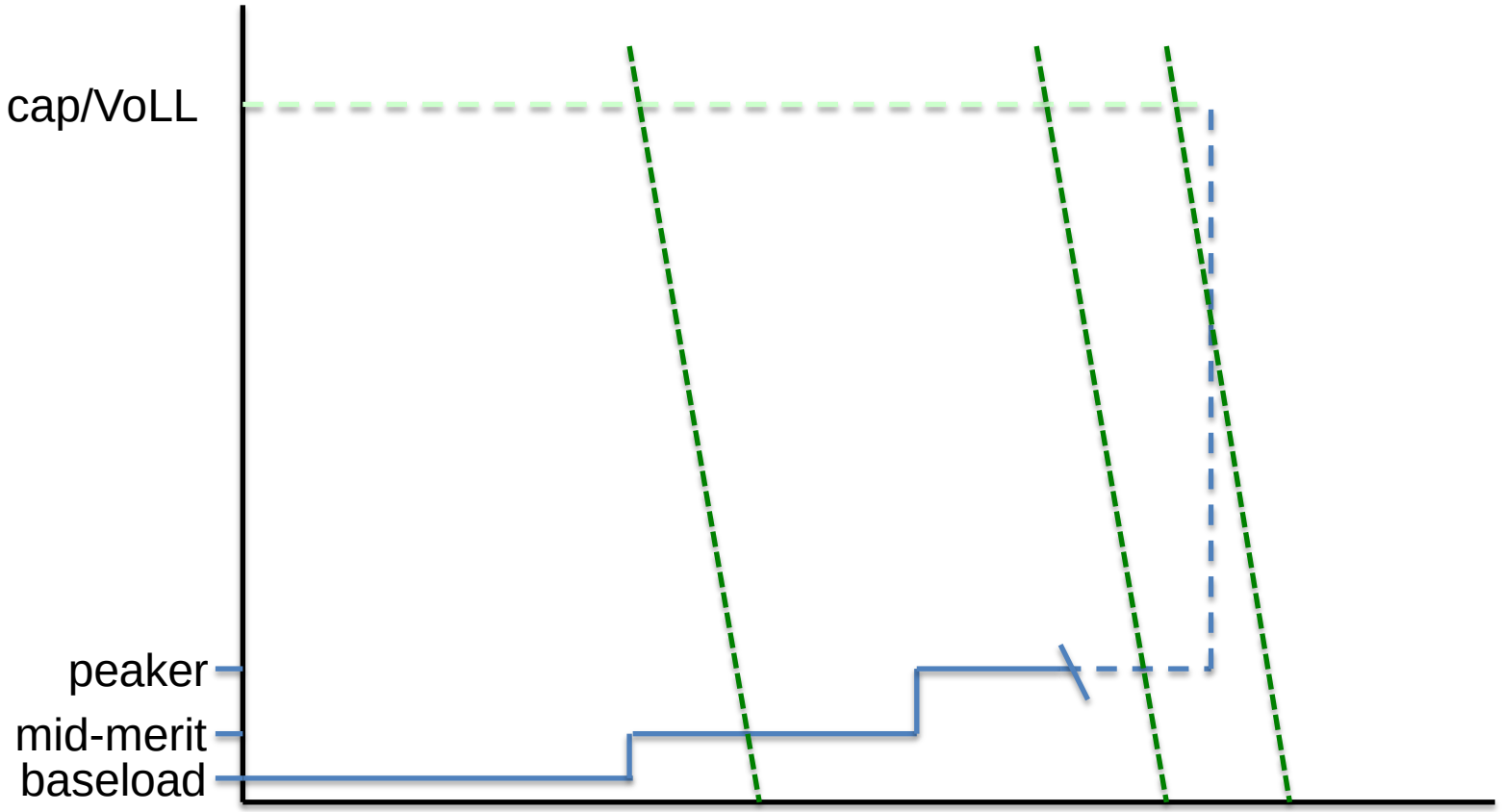
PJM: The "Polar Vortex"

pjm

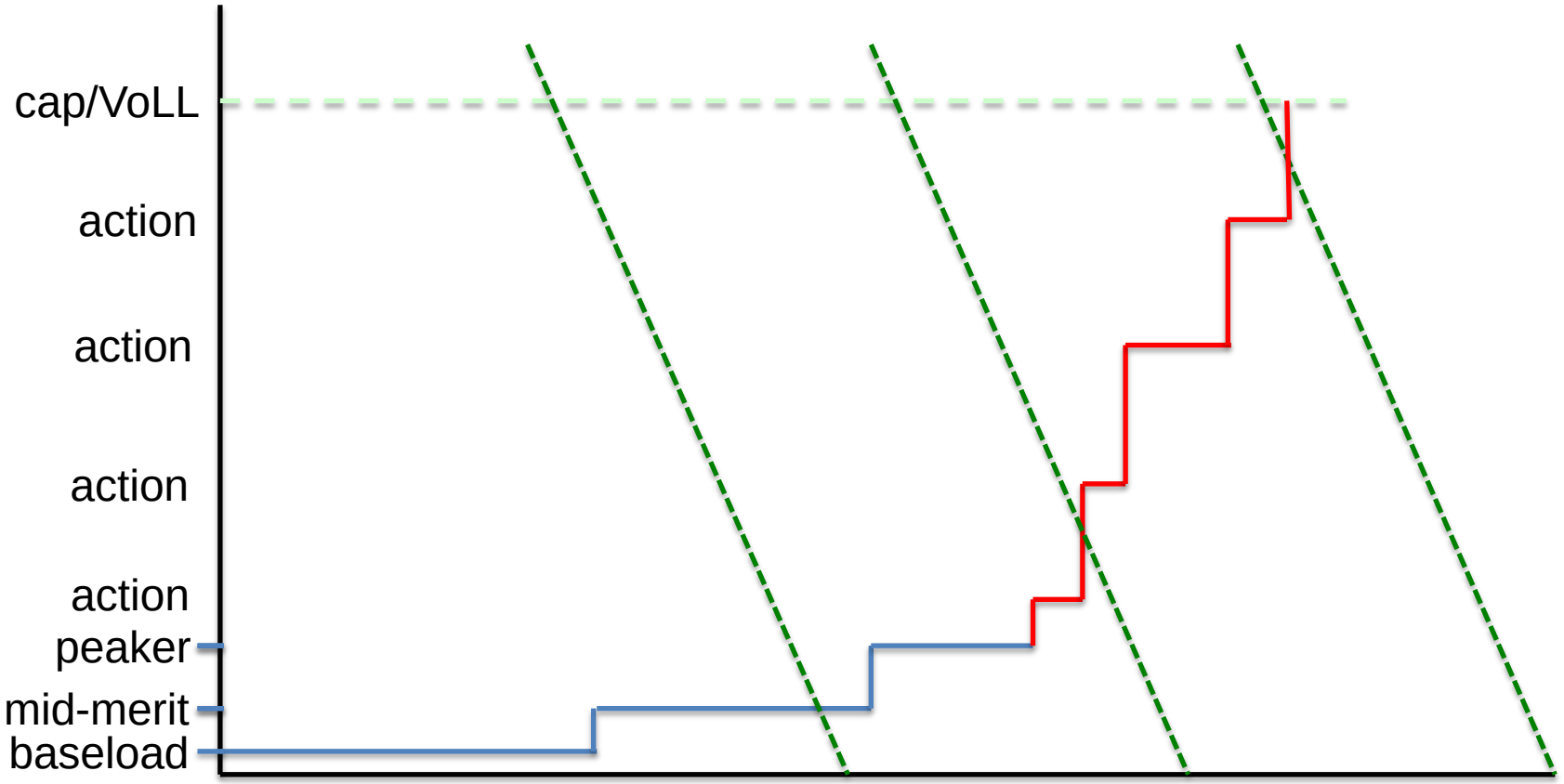
Generation Outages for 1/6 – 1/8/2014

OUTAGES	RTO	Diesel/C	Steam/Fossil	Nuclear	Combined Cycle	Hydro	Wind	Other	Gas curtailments
Monday 1/6/2014 8 p.m. Eastern	30,239	8,120	16,116	2,047	1,665	59	1,200	1,032	2,160
Tuesday 1/7/2014									
8 a.m.	35,069	11,238	16,910	1,605	2,299	63	1,313	1,641	7,489
7 p.m.	38,033	12,374	18,784	1,605	2,358	61	1,554	1,297	6,368
Wednesday 1/8/2014									
8 a.m.	39,520	13,962	19,114	1,605	2,294	67	1,491	987	9,046
8 p.m.	27,044	9,050	14,281	892	889	53	1,152	727	9,046

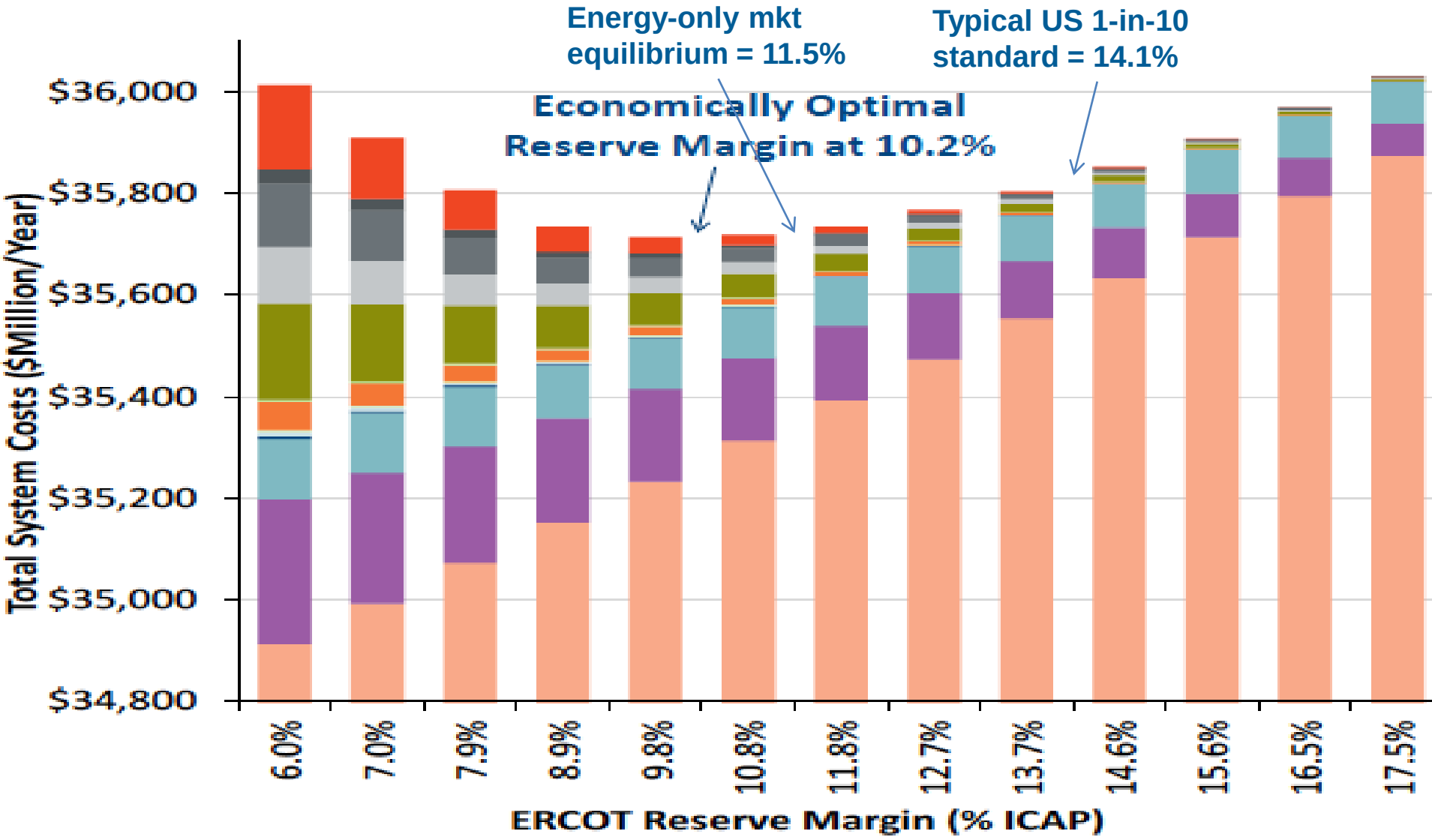
Typical view: wholesale supply/demand curve



Supply/demand (corrected)



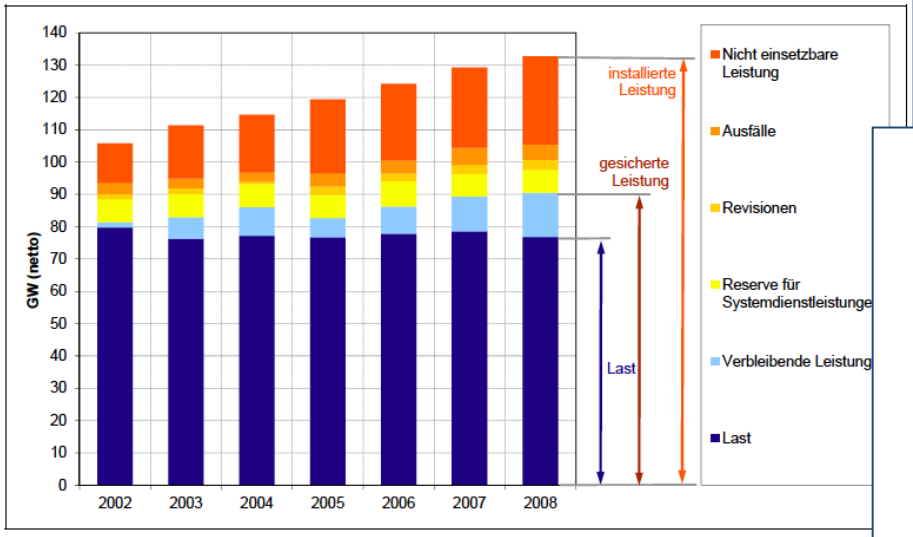
Target reserve margin analysis in ERCOT



Source: Brattle Group (amended)

Germany & Europe: Oversupplied with capacity

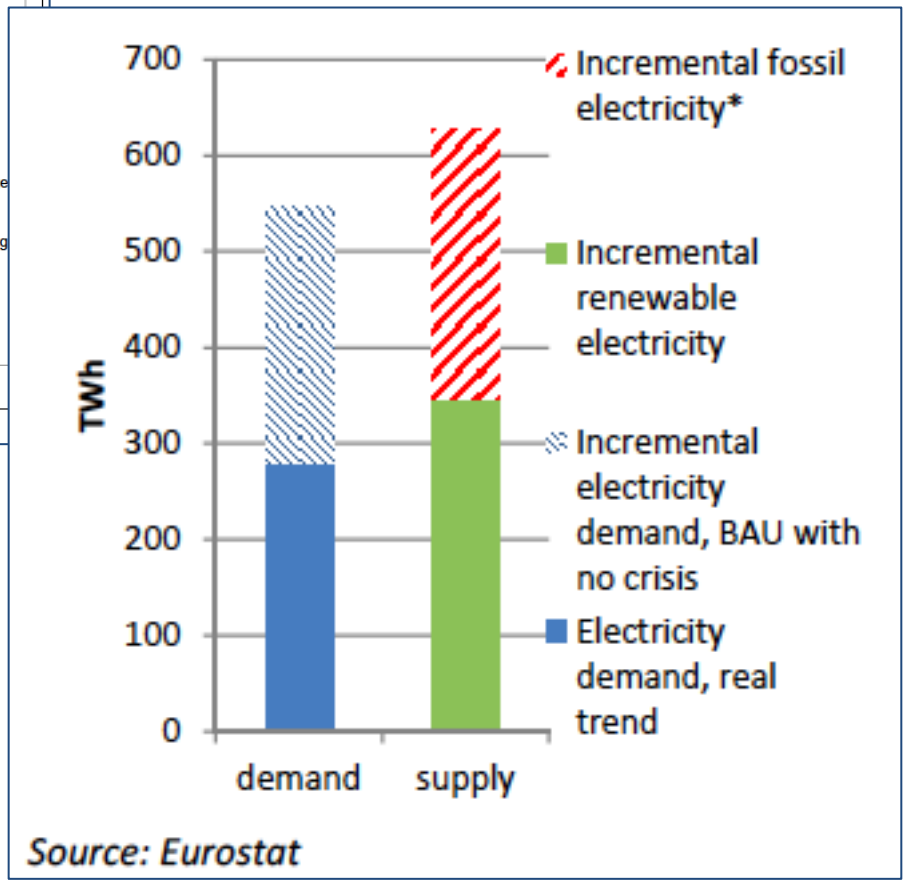
Abbildung 3 Leistungsbilanz der allgemeinen Stromversorgung in Deutschland zum Zeitpunkt der Jahreshöchstlast



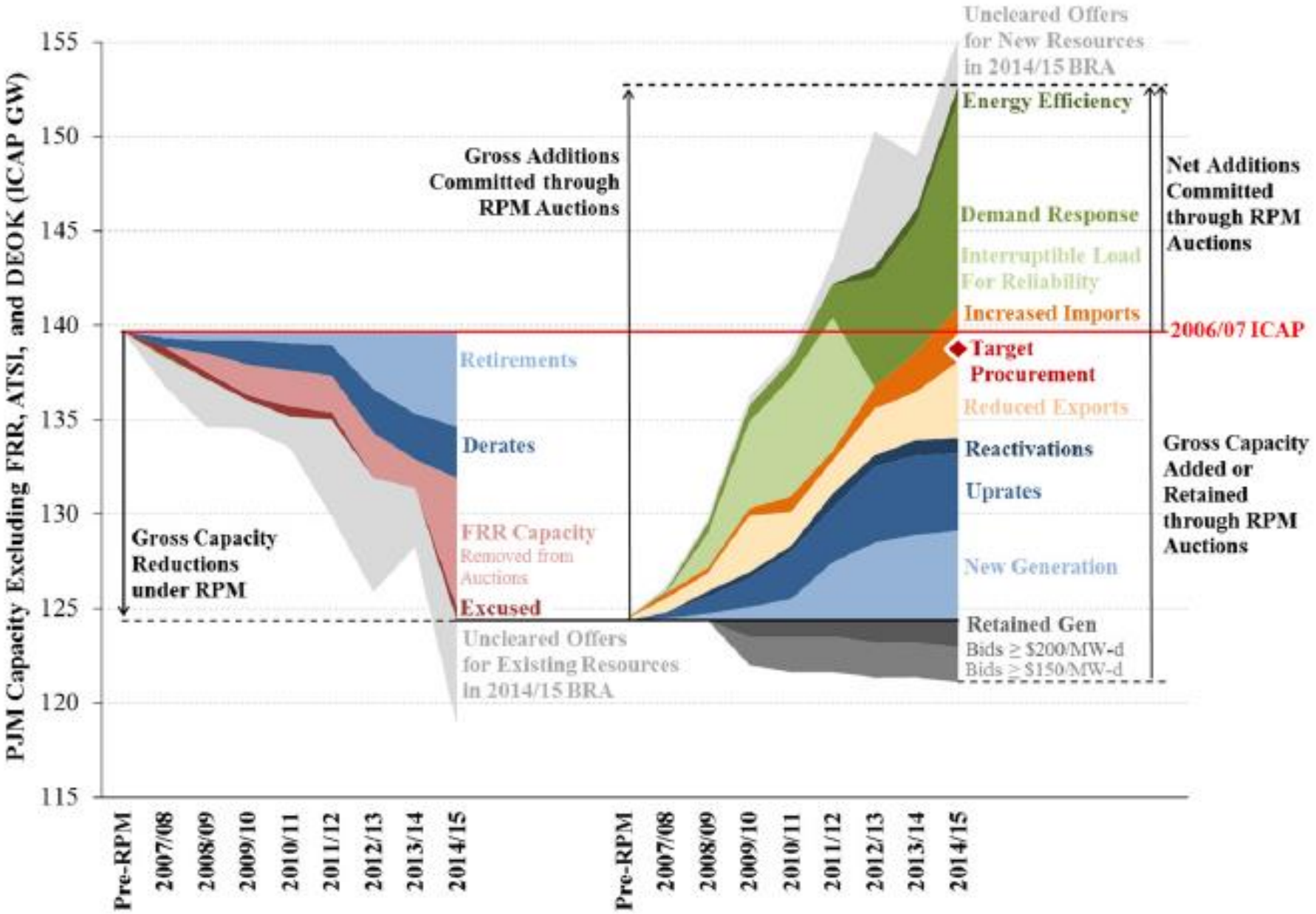
Quelle: BDEW, VDN

German reserve margins ‘02-’08

EU incremental energy balance ‘00-’12



Source: Eurostat


PJM Capacity Excluding FRR, ATSI, and DEOK (ICAP GW)
155
150
145
140
135
130
125
120
115
Pre-RPM
2007/08
2008/09
2009/10
2010/11
2011/12
2012/13
2013/14
2014/15
Gross Capacity Reductions under RPM
Retirements
Derates
FRR Capacity Removed from Auctions
Excused
Uncleared Offers for Existing Resources in 2014/15 BRA
Gross Additions Committed through RPM Auctions
Uncleared Offers for New Resources in 2014/15 BRA
Energy Efficiency
Demand Response
Interruptible Load For Reliability
Increased Imports
Target Procurement
Reduced Exports
Reactivations
Uprates
New Generation
Retained Gen
Bids ≥ $200/MW-d
Bids ≥ $150/MW-d
2006/07 ICAP
Net Additions Committed through RPM Auctions
Gross Capacity Added or Retained through RPM Auctions

Demand response has been very reliable

Real-Time Demand Response dispatched by ISO New England

July 19, 2013 13:35 – 20:35.

Load Zone	Obligation (MW)	Performance (MW)	Percent
CT	87.1	81.2	93.2%
NEMA	25.4	26.0	102.5%
NH	3.6	9.8	276.9%
RI	19.4	8.2	42.3%
SEMA	10.1	9.6	94.9%
VT	23.0	29.3	127.1%
WCMA	24.7	19.7	79.7%
Total	193.3	183.8	95.1%

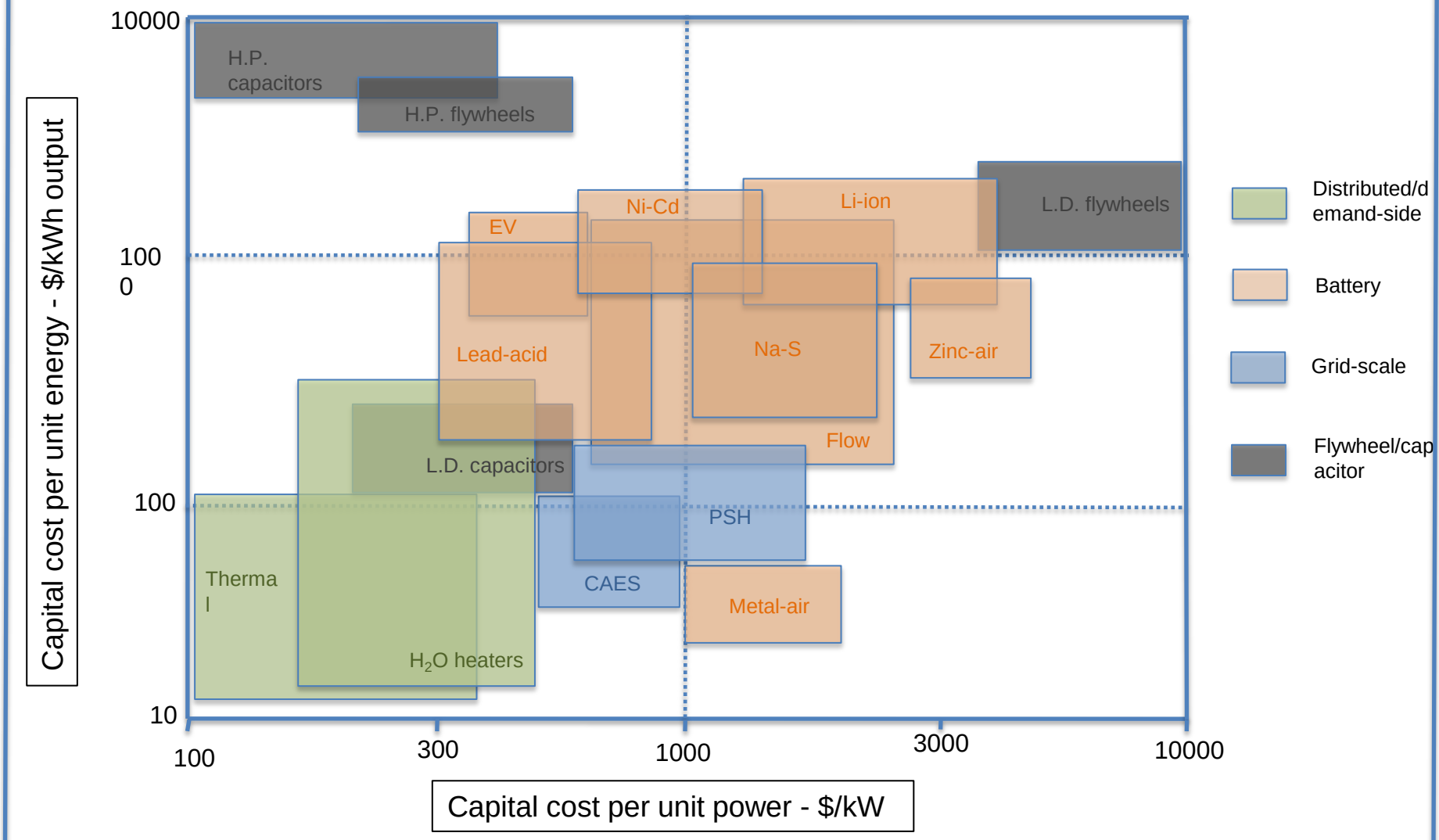
Jan 28, 2013 from 6pm – 8pm.

		Performance	
State	Net CSO (MW)	MW	%
CT	75.3	52.0	69.1%
ME	141.5	197.5	139.6%
NEMA	17.7	19.3	109.4%
NH	21.4	13.9	65.0%
RI	18.4	13.9	75.6%
SEMA	12.8	9.5	74.3%
VT	36.3	33.3	91.7%
WCMA	49.8	32.1	64.5%
Total	**373.1**	**371.6**	**99.6%**

Demand Response maintained guaranteed delivery amounts well beyond the peak hour, even as customer loads were falling.

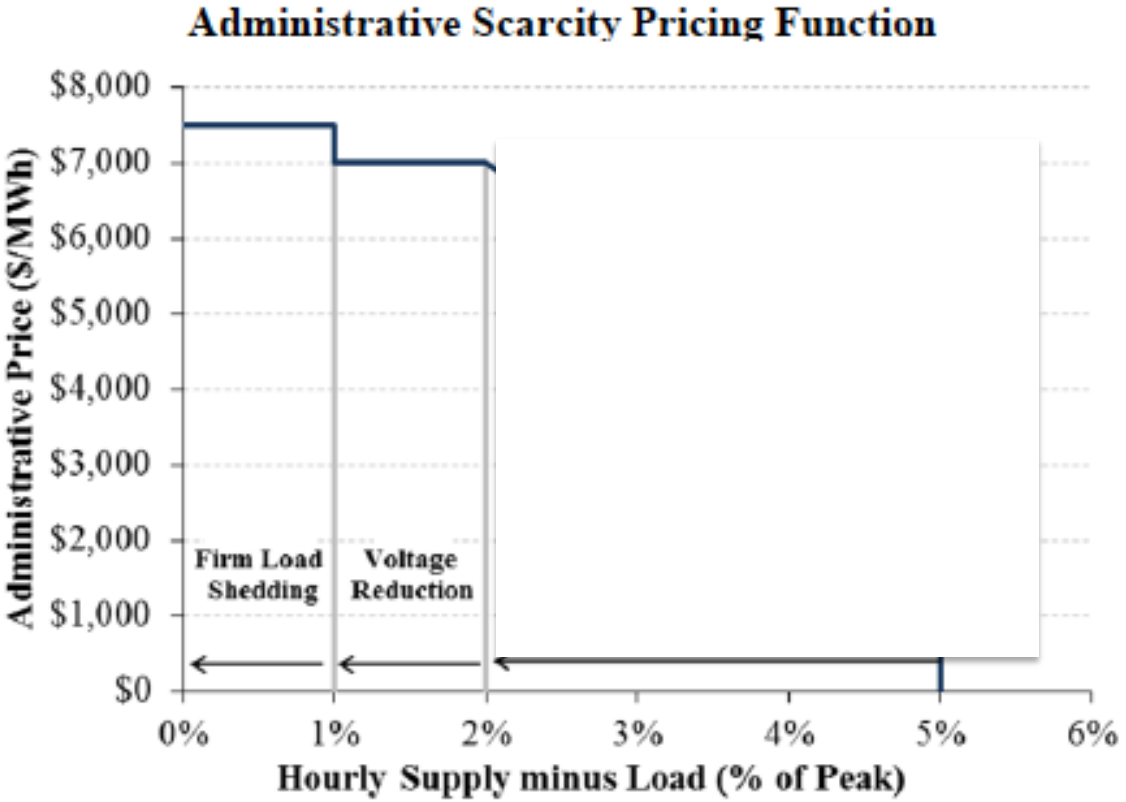
Source: ISO New England.

Cost per Unit of Performance for Various Energy Storage Options



Sources: Electricity Storage Association, EPRI, Sandia National Laboratories, Ecofys

Current approach to pricing/valuing reserves

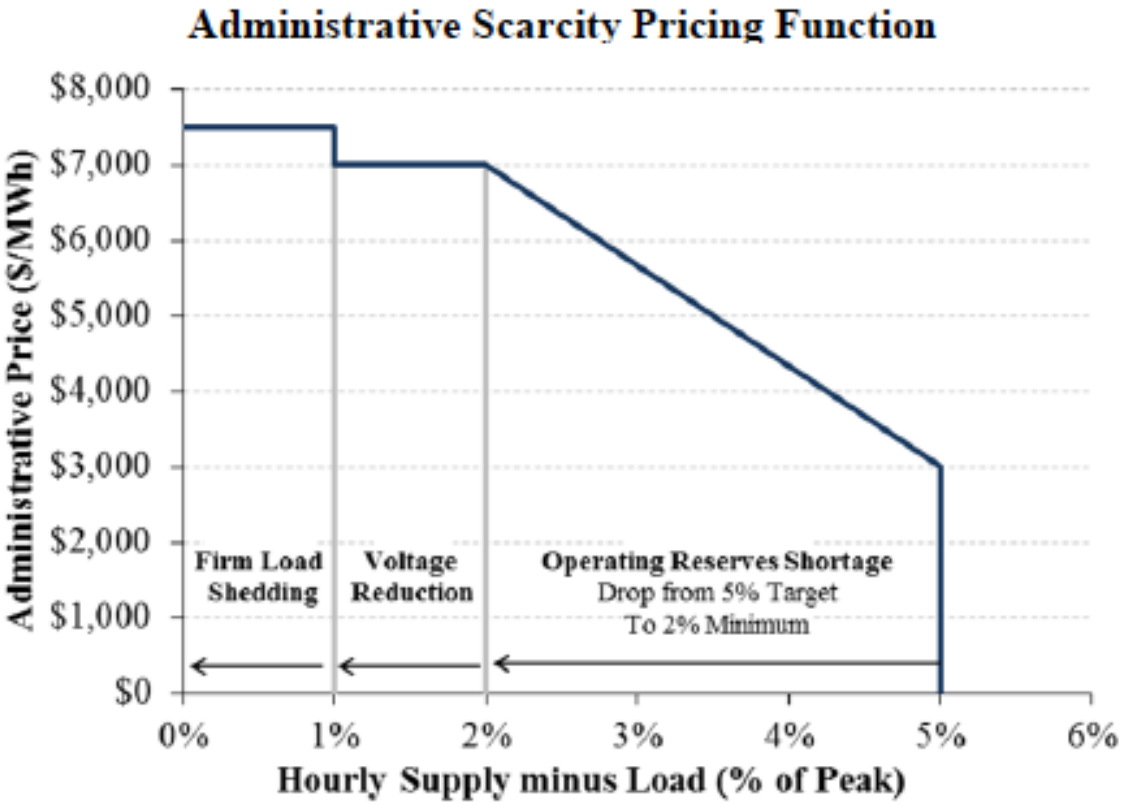


Notes:

Horizontal axis of the administrative pricing curve is calculated as a percent of peak load and does not vary with system conditions.

Source: Brattle Group

ORDC (PJM, ERCOT): a “capacity/energy” market

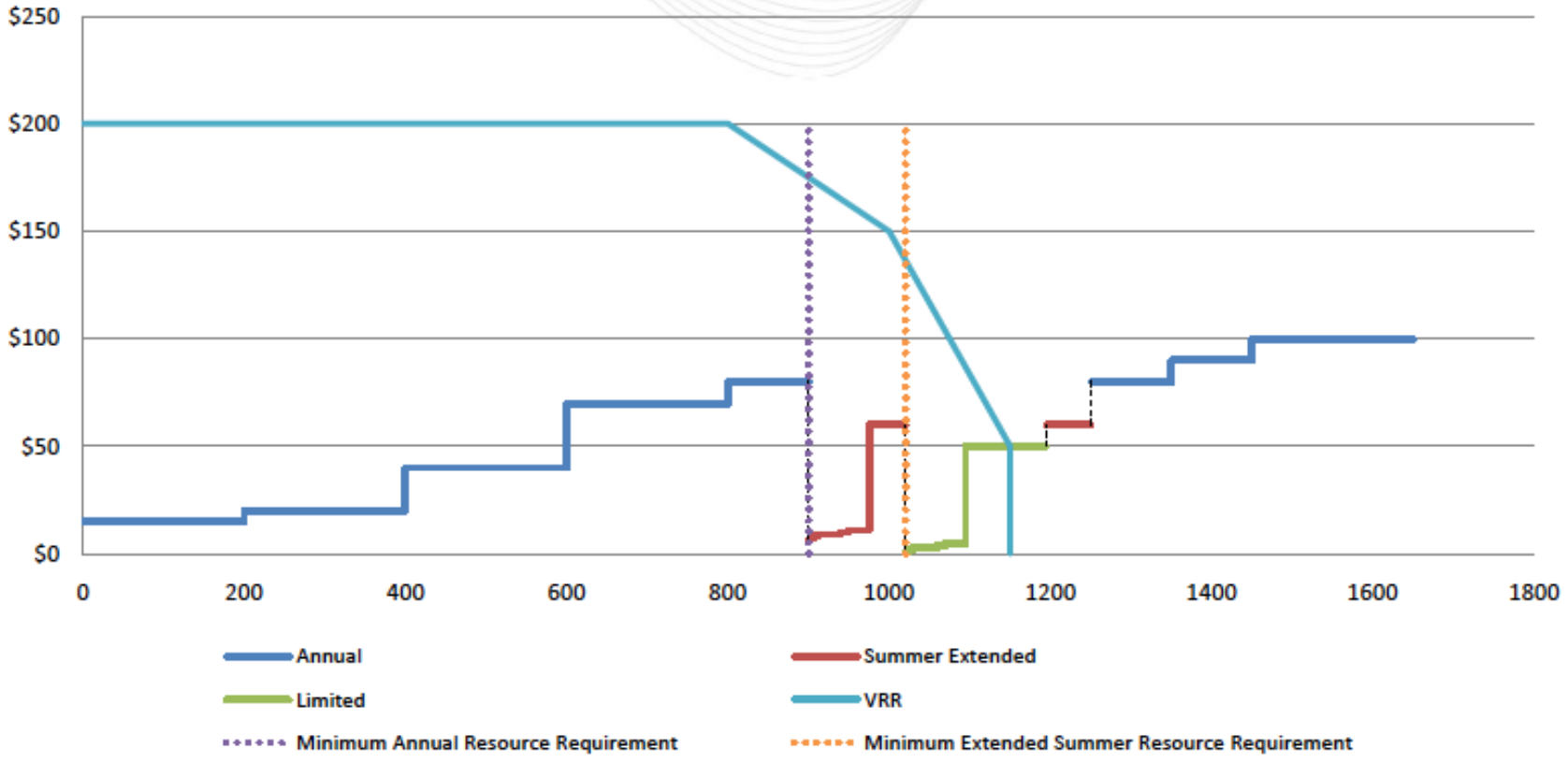


Notes:

Horizontal axis of the administrative pricing curve is calculated as a percent of peak load and does not vary with system conditions.

Source: Brattle Group

A market for resource *capabilities*



Marginal Value Of System Capacity = $50
Annual Resource Price Adder = $20
Extended Summer Price Adder = $10

Source: Brattle Group

About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

Learn more about RAP at www.raponline.org

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