Current Demand Response opportunities

Summer Only DR STF

12/13/17

Wholesale Service	Demand Response	PRD
Capacity	Yes	Yes
Energy	Yes	
Day Ahead Scheduling Reserves (30 min)	Yes	
Synchronized Reserves (10 min)	Yes	
Regulation	Yes	

Emergency Energy Only

Load Management (Emergency Pre-Emergency)

Economic DR

- Load Management (Emergency/Pre-Emergency DR)
- Price Responsive Demand (PRD)
- Emergency Energy Only DR
- Economic DR

| Product	16/17	17/18	18/19	19/20	20/21
Limited DR	X	X			
Extended Summer DR	X	X			
Annual DR	X	X			
Base DR			X	X	
Capacity Performance DR	X	X	X	X	X
Summer Period DR					X

FRR – LDR/XDR/ADR through 18/19, 19/20 Base/CP, 20/21 CP

# CP Demand Resource transition to be more consistent with other capacity resources

Requirement	(Today) Limited DR (15/16 – 17/18)	(Today) Extended Summer DR (15/16 – 17/18)	(Today) Annual DR (16/17 – 17/18)	(CP) Base Capacity DR (18/19 & 19/20 DY only)	(CP) Capacity Performance DR (16/17 DY & beyond)	(CP) Summer Period DR (20/21 and beyond)
Availability	Non-NERC holiday weekday, June – Sept	June – Oct & May	Any day during DY*	June - Sep	Any day during DY*	June – Oct & May
Maximum Number of Interruptions	10 interruptions	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited
Hours of Day Required to Respond (Hours in EPT)	12:00 PM – 8:00 PM	10:00 AM – 10:00 PM	June – Oct & May: 10 AM – 10 PM Nov. – April: 6 AM- 9 PM	10:00 AM – 10:00 PM	June – Oct. & May: 10 AM – 10 PM Nov. – April: 6 AM- 9 PM	10:00 AM – 10:00 PM
Maximum Duration of Interruption	6 Hours	10 Hours	June – Oct : 12 hours Nov – April: 15 hours	10 Hours	June – Oct : 12 hours Nov – April: 15 hours	12 Hours

*unless on an approved maintenance outage during Oct – Apr.
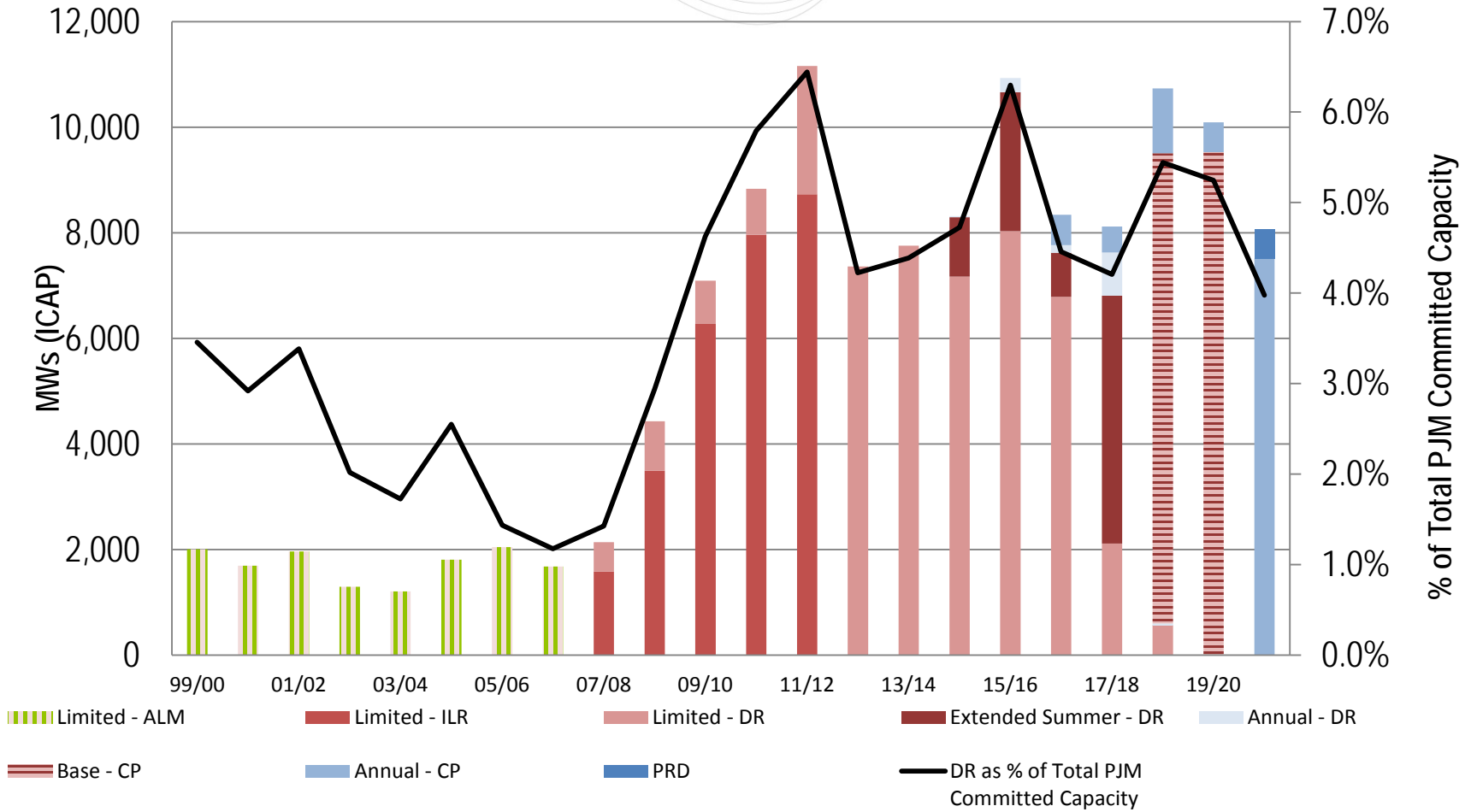
PRD, 558

DR - Summer
Only, 289

DR - Annual,
7,531
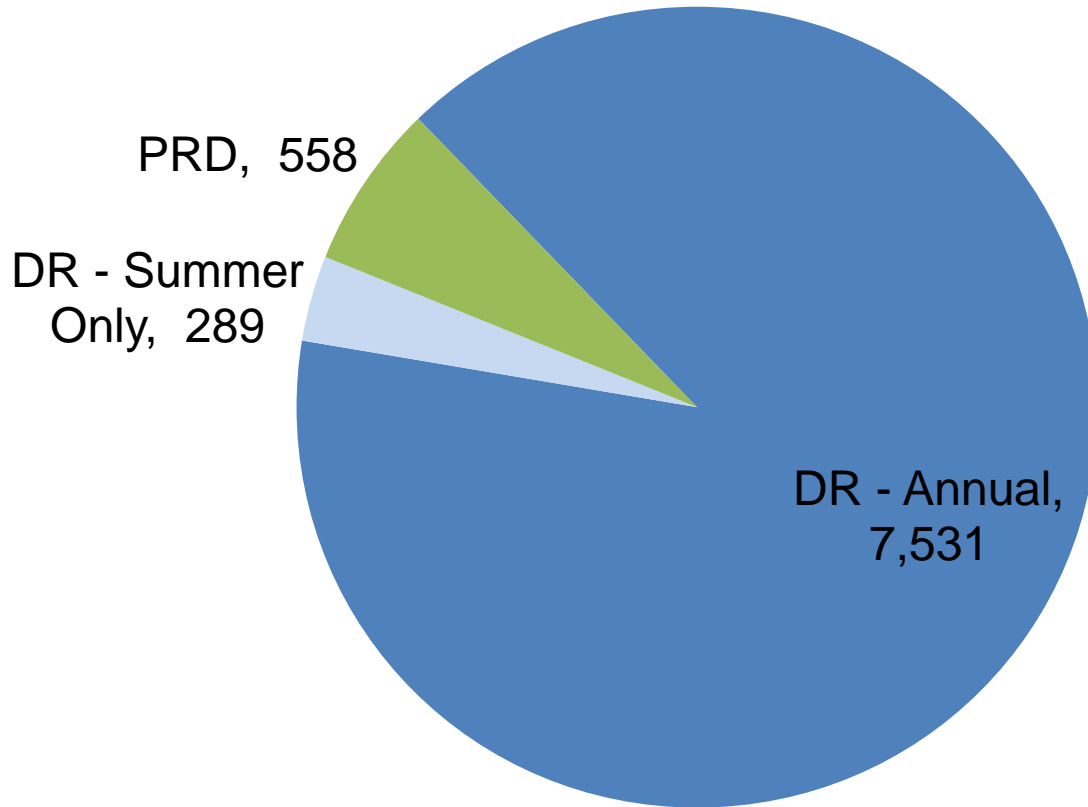
*First BRA with
no stand-alone
summer only
DR product*

- Offer in auction up to 3 years in advance
- Load must be reduced within 30 minutes unless qualify for exception (60, 120 minutes)
  - Safety, potential damage, generation startup, mass market communication
- DR dispatched on zonal or sub-zonal basis
  - PJM will dispatch specific "registrations" required to respond
- Paid for energy up to offer price.
  - Energy price cap based on lead time
- Required to test for 1 hour if not dispatched
  - Penalty for failure (revenue rate + 20% or $20)
- Capacity commitment penalty
  - Same as test penalty
- Hourly metering required

- Load reductions must be available year-round
  - June through Oct & May (Summer): 10am to 10pm
  - Nov through April (Winter): 6am to 9pm
- Capacity commitment
  - lessor of:
    - Summer nominated capacity = PLC – [FSL(summer) * line loss factor)
    - Winter nominated capacity = {Winter Peak Load * Winter Weather Adjustment Factor – FSL (winter)} * line loss factor
- Performance measurement
  - Meter load compared to Summer or Winter FSL
  - Summer load reduction based on peak load contribution ("PLC") assigned by utility
  - Winter load reductions based on winter peak load (WPL)
- Hourly/Interval Penalty if load is not reduced (~$3,500 MWh)
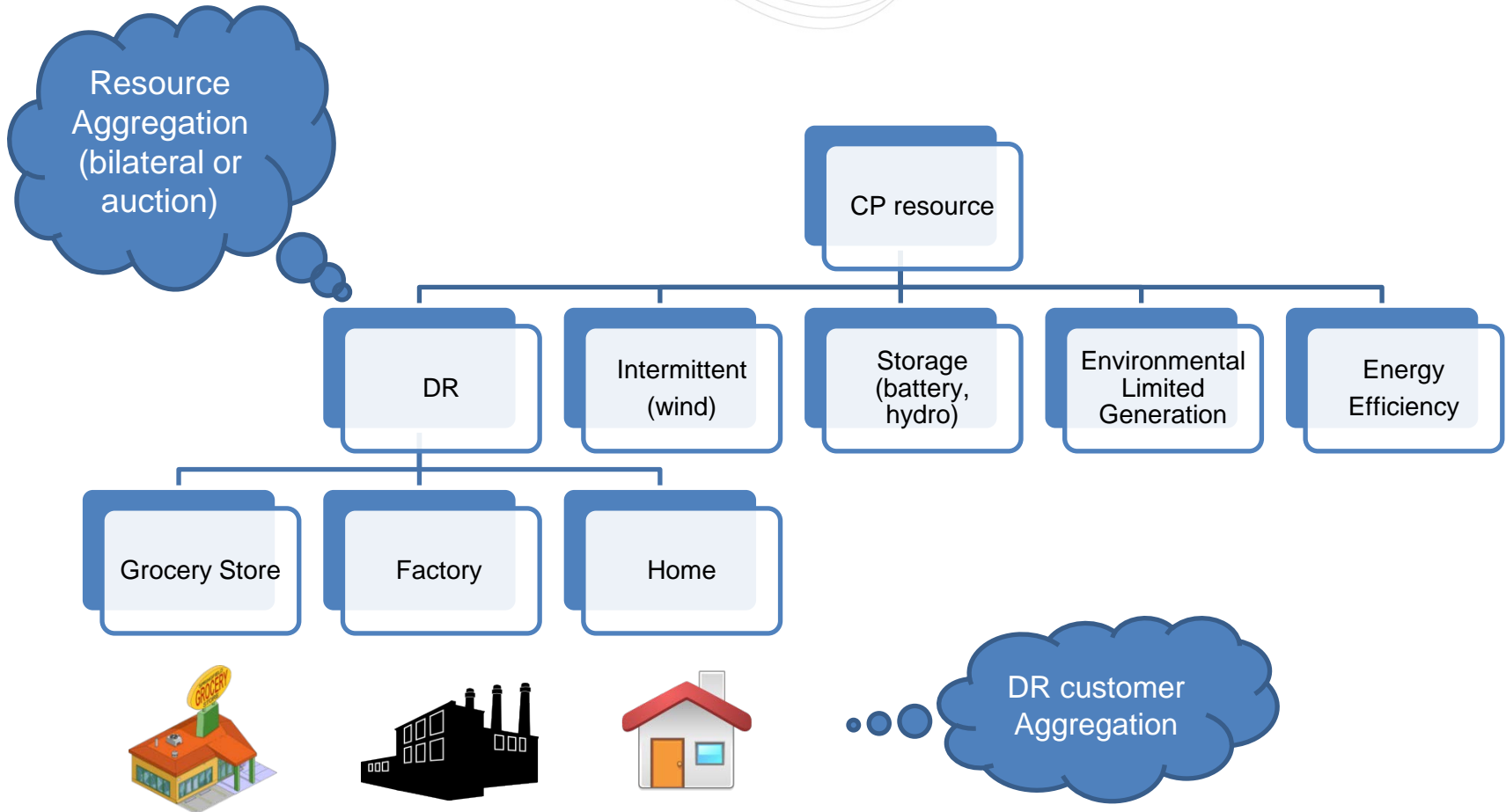
- June through Oct and May (6 months)
- Receive 6 months of capacity revenue
- Everything will be handled similar to Extended Summer DR except:
  - 6 months of revenue
  - Only clears if there are winter resources (additional winter capability)
  - CP penalty structure (PAH, penalty rates)

- Load Management (Emergency/Pre-Emergency DR)
- Price Responsive Demand (PRD)
- Emergency Energy Only DR
- Economic DR

PRD vs. Real Time LMP
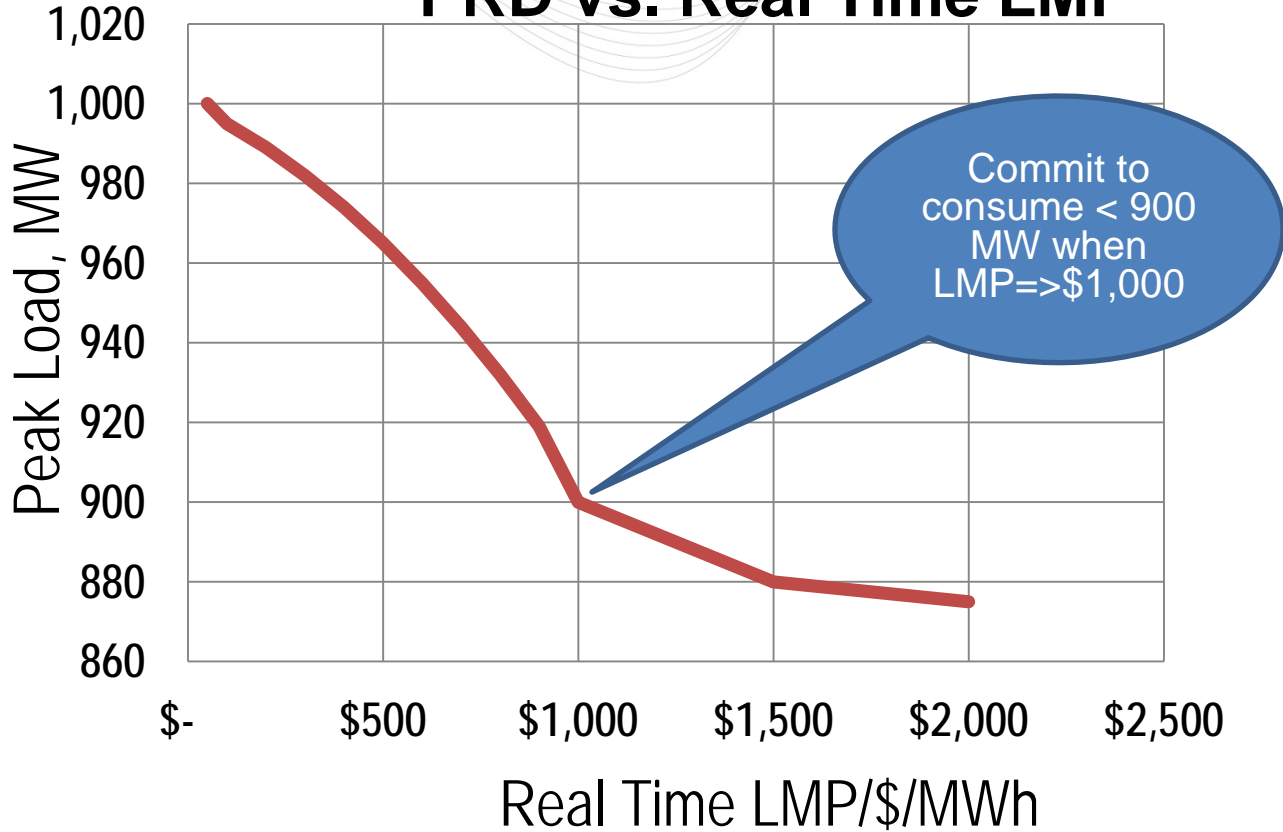
Price Responsive Demand (PRD) – load that will automatically respond to energy prices and be off the grid during PJM emergency in exchange for reduction in capacity requirement.
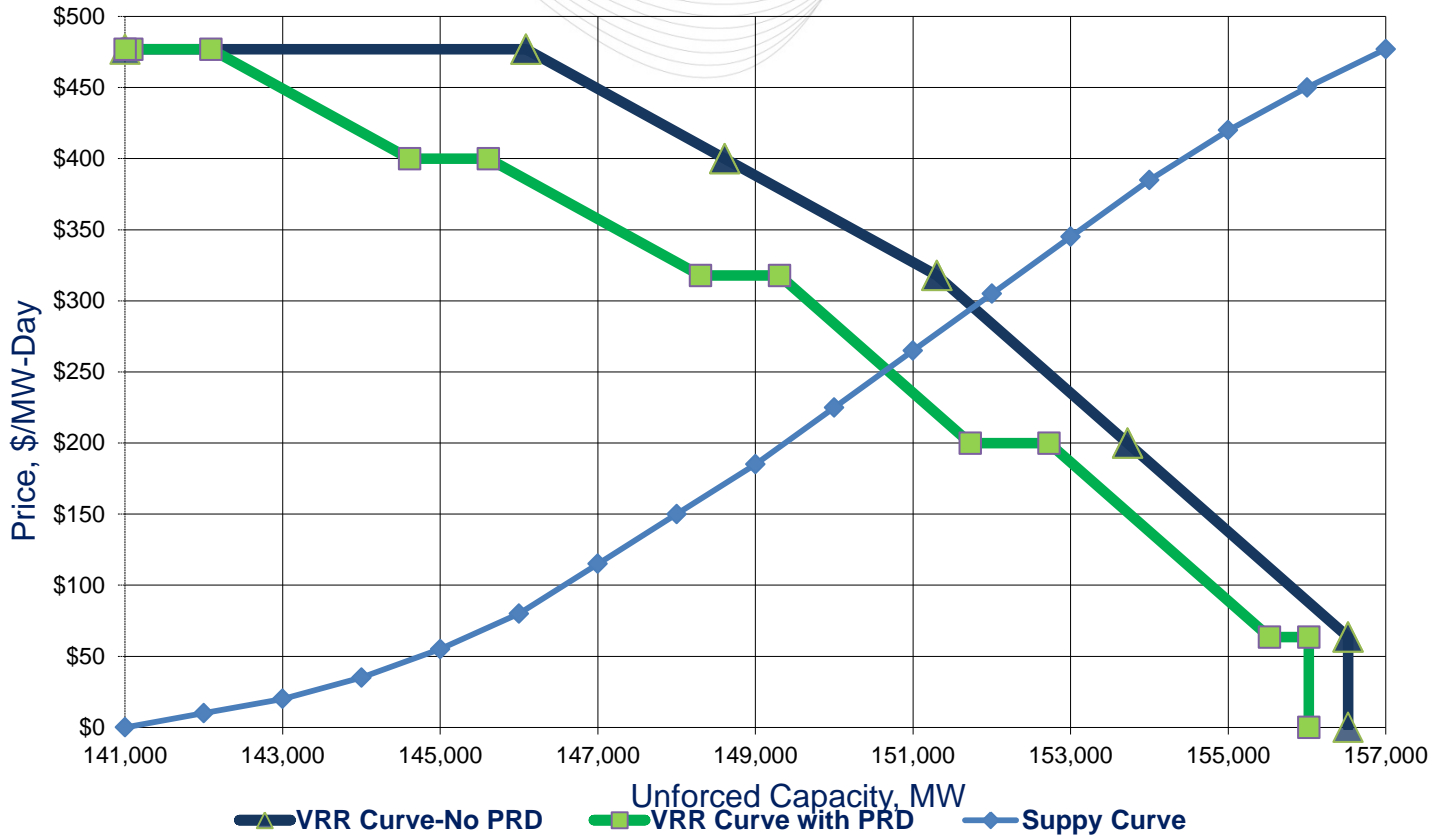
PRD will shift or change the demand curve which will reduce the overall capacity requirement

Process	PRD	DR/CP
RPM	BRA or 3rd IA if forecast goes increases, No replacement, Submit PRD plan, PRD provider only. Credit based on the Base Capacity rates	BRA and IAs, replacement allowed, Submit DR plan, CSPs provide. Credit based on new CP rates (higher than base rates)
Revenue	No revenue – bill credit to LSE based on FZCP if cleared in BRA. No energy market revenue. If PRD provider different from LSE then members must work out bilateral arrangements	Revenue to CSP based on auction clearing price. Energy market revenue based on full LMP
Registration	LSE required and pnode required (and limits aggregation), Dynamic retail rates (linked to nodal LMP). Not allowed to participate as economic DR	No LSE required. Registration not permitted after start of DYs.
Reporting	PRD hourly curve (load and LMP) by pnode	Expected reductions by dispatch group
Dispatch & Notification	PRD provider dispatches from price curve and supervisory control during Max Emergency. Eligible to set LMP. May have price curve of 1 point at energy offer cap	PJM dispatch/release by zone/subzone by type by lead time. Eligible to set LMP. PJM dispatches based on system needs when short on reserves
Verification	Adjusted MESL (compared to PLC) – max hour of event	Summer FSL (compared to PLC) and Winter FSL (compared to WPL). Hourly basis
Penalty	Daily deficiency charge (FZCP * > of 1.2 or $20/mwday Event – same as daily deficiency charge * 365	Daily deficiency charge (RPM price * > of 1.2 or $20/mwday Event – Net Cone * 365/30
Testing	Same	same
Add Back	Based on emergency event and 5 CPs	Based on emergency and economic events

- Stakeholder process to change PRD requirements deferred until outcome of SODRSTF proposal(s) endorsement.

- Load Management (Emergency/Pre-Emergency DR)
- Price Responsive Demand (PRD)
- Emergency Energy Only DR
- Economic DR

- Designed for easy access to reduce load during PJM emergency conditions
- Voluntary (no penalties)
  - if you can reduce load, you are paid
  - if can not reduce load, you are not paid.
- Dispatched by PJM as separate emergency procedure
- Revenue based on energy offer price (price cap same as Economic DR)

Originally designed to be similar to Emergency Energy purchase rules

- Load Management (Emergency/Pre-Emergency DR)
- Price Responsive Demand (PRD)
- Emergency Energy Only DR
- Economic DR

- Energy – dispatched when economic to participate based on offer and availability.
  - Day ahead and/or real time energy market
    - Allowed to submit up to 10 price/quantity pairs (curve)
  - Customer baseline ("CBL") determines load reduction
    - Load reduction should reflect activity done specifically for wholesale market
  - Payment based on Locational Marginal Price
  - Hourly metering required

Figure 1: 2017 Economic Demand Response Monthly Energy Market Revenue

incomplete

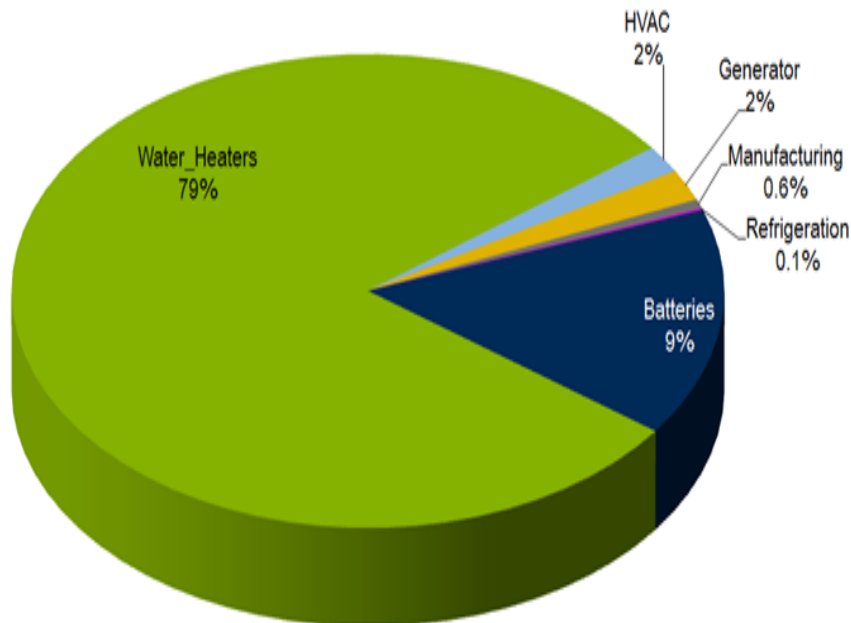| State	Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
DC	PEPCO							$2,823				
IL	COMED	$2,832	$261	$13,524	$6,251	$31,122	$9,029	$38,292	$19,103	$15,691	$14,889	$20,369
MD	BGE							$132,077	$491	$266	$251	
	DPL							$23,732				
	PEPCO							$50,820				
NJ	AECO			$0								
	JCPL						$29,517	$45,083	$10,979			
	PSEG	$56,409	$20,863	$53,951	$56,078	$73,938	$79,778	$55,275	$85,616	$65,062	$47,827	$9,334
OH	AEP			$4								
	ATSI				$3,593	$571	$32,029	$43,658	$39,204	$72,851	$45,542	
	DEOK							$12,682		$8,440		
PA	APS							$10	$139	$5,416		
	METED	$125	$258	$1,594	$2,011	$957		$1,373	$59		$926	$414
	PECO	$2,130		$2,816		$22,205	$851	$4,967	$939	$15,630		
	PENELEC	$25,741	$16,088	$19,382	$41,126	$30,043	$38,078	$8,460	$41,937	$53,805		
	PPL					$6,546	$25,607	$23,586	$1,546	$5,376	$8,128	
VA	DOM	$259,396	$4,883	$21,303		$139,793	$85,430	$0	$44	$2,544		
WV	APS	$0		$0	$0	$0	$4,717	$4,548		$4,808		
Total		**$346,632**	**$42,353**	**$112,574**	**$109,060**	**$305,174**	**$305,037**	**$447,387**	**$200,056**	**$249,891**	**$117,564**	**$30,118**

Total CSP Credits: $2,265,844
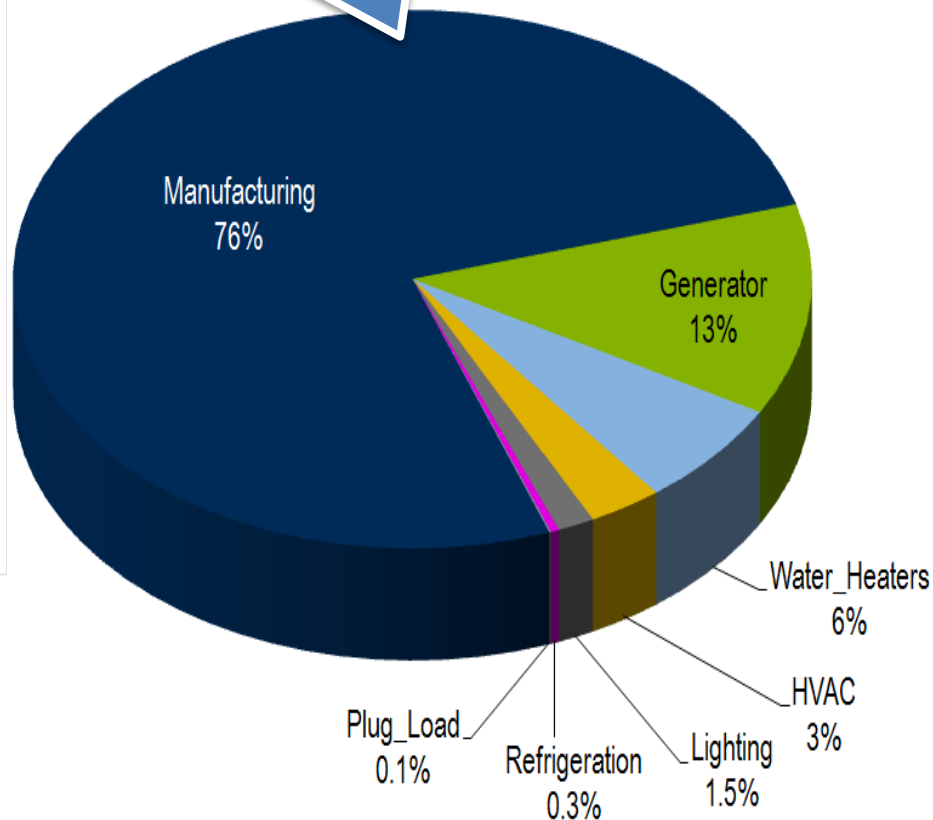
70% in Real Time market and 30% in Day Ahead market

- Day Ahead Scheduling Reserves – must be able to respond to real time dispatch in 30 minutes
  - DR participation limit is 25% of requirement
  - 1 minute metering required
- Synchronized Reserves – must reduce load within 10 minutes during reserve shortage
  - DR participation limit is 33% of requirement
  - 1 minute metering required
- Regulation – real time load change (increase and decrease) based on real time system conditions
  - DR participation limit is 25% of requirement
  - Real time telemetry required
  - Test requirement

DR Synchronized Reserves = 110 MW hourly average commitment (PJM total 1,450).

DR Regulation = 10 MW hourly average commitment (PJM total 700 MW on peak, 525 MW off peak).

Left pie chart:
- Water_Heaters 79%
- HVAC 2%
- Generator 2%
- Manufacturing 0.6%
- Refrigeration 0.1%
- Batteries 9%

Right pie chart:
- Manufacturing 76%
- Generator 13%
- Water_Heaters 6%
- HVAC 3%
- Lighting 1.5%
- Refrigeration 0.3%
- Plug_Load 0.1%

- DR customer aggregation compliance example

CBL = PLC

CBL = WPL * WWFA

eRPM and eLSE information							Summer Event				Winter Event			
eRPM Resource	eLRS Registration	eLRS Location Name	EDC Acct #	PLC	Capacity Loss Factor		CBL	Load	Load * losses	Load Reductions (w/losses)	CBL	Load	Load Reductions	Load Reduction (w/losses)
PECO CP	Reg1	CP_SkiSlope	98237410290	1	1.05		1	1	1.05	-0.05	4	1	3.00	3.15
		CP_Commercial1 AC	80189273488	2	1.05		2	0.7	0.74	1.27	1.5	1.75	-0.25	-0.26
		CP_Commercial2 AC	71280398411	2	1.05		2	1.1	1.16	0.85	1.5	1.25	0.25	0.26
		CP_Commercial3 AC	71280398413	2	1.05		2	1.3	1.37	0.64	1.5	1.5	0.00	0.00
				7	1.05					2.70				3.15
Registration Nomination														
		Firm Service Level		4										
		Nominated Icap		2.8			**Performance (ICAP)**			**-0.11**	**Performance (ICAP)**			**0.35**

Assume commitment is same as nominated amount

Shortfall - Potential Penalty

Over – Potential Bonus Payment