2017 Distributed Energy Resources (DER) that participate in PJM Markets as Demand Response

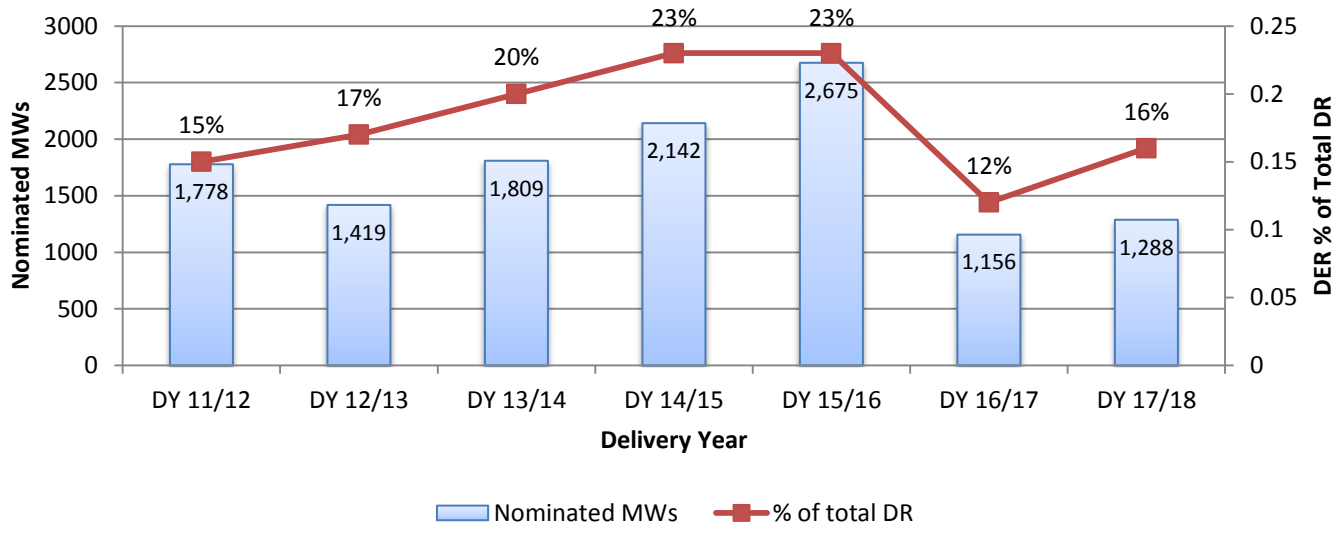
PJM Demand Side Response Operations

January, 2018

This page intentionally left blank

For the purposes of this report PJM will refer to behind the meter devices capable producing electricity in Demand Response as “DR DER”.

Figure 1: Demand Response from DER in Capacity Market



DER participation in the Capacity Market as Demand Response, represented here both in MW volume and as a percentage of overall Demand Response volume, showed steady growth through 15/16 DY and then dropped by over 50% in16/17 DY. For 17/18 DY the amount of DR DER went up by 130MW and it’s share of total DR increased by 4% from the previous delivery year.

Observation: Based on discussions with CSPs, PJM believes the drop in 16/17 DY was due to U.S. Court of Appeals for the District of Columbia Circuit issuing a mandate (May 1, 2015) vacating specific RICE NESHAP and NSPS provisions for Emergency Engines with the further guidance released by the EPA on April 15, 2016.

Figure 2: DER Capability in DR Programs (2017 for Economic and 17/18 DY for Load Management)

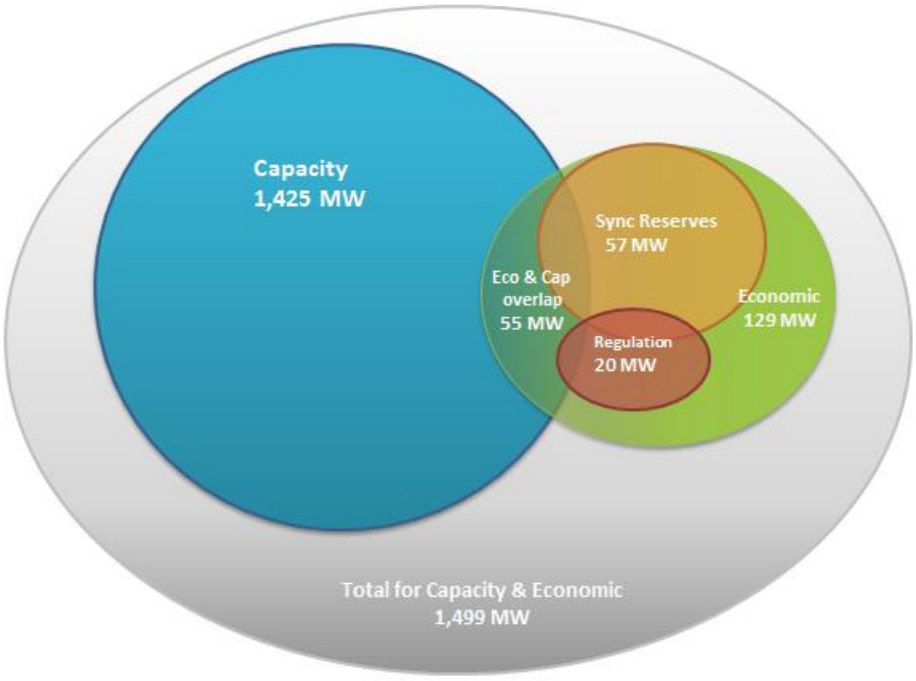
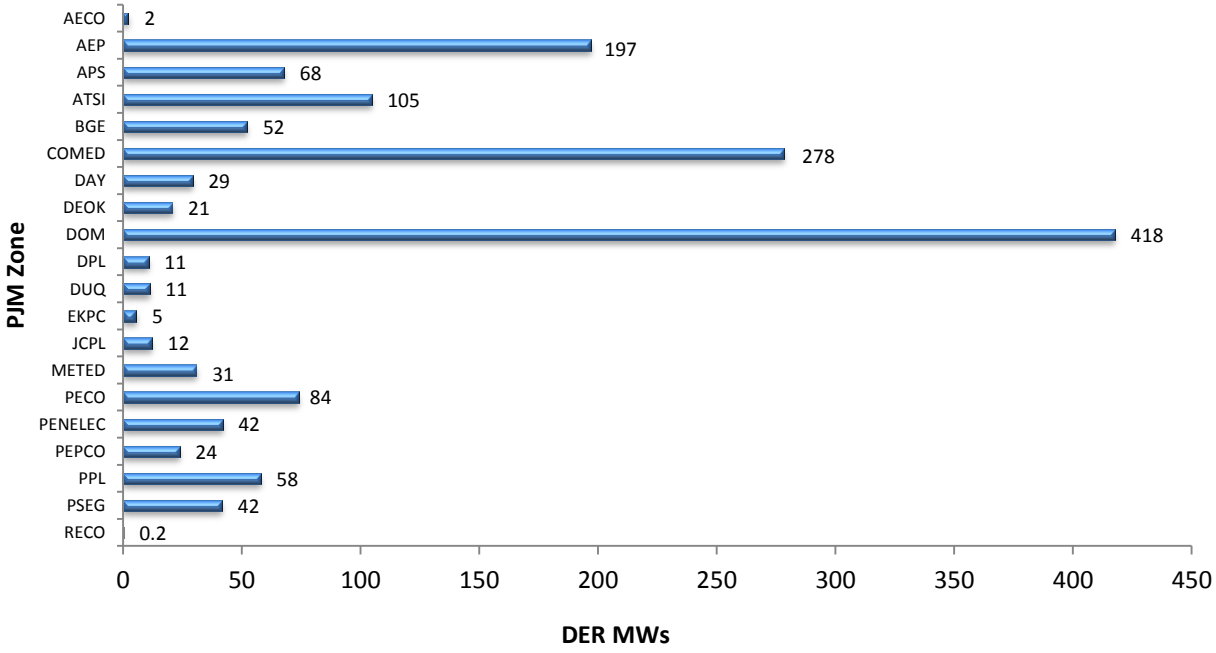


Figure 2 shows MW capability of DERs registered in Demand Response programs. Of 1,425 MW registered in capacity market only 55 MW also participate in economic programs. 74 MWs of capability are registered in economic programs only. This brings total DR DER capability to 1,499 MWs. The majority of DER participating as economic DR have been certified to provide ancillary services (77 MW).

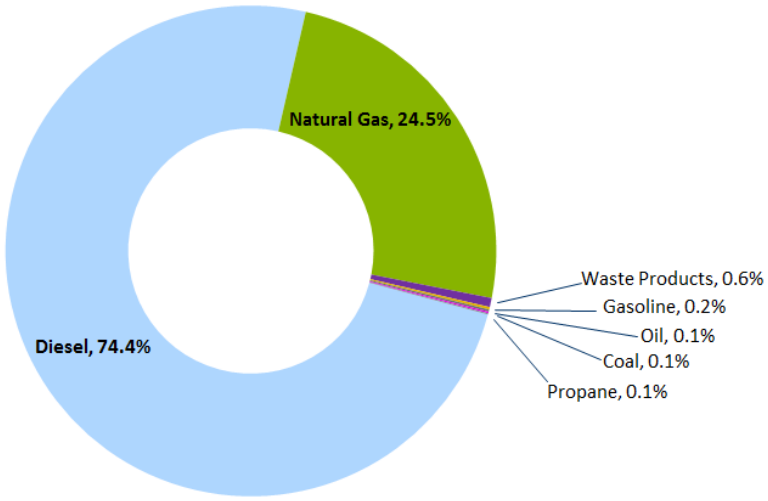
Notes: Values are CSP reported nameplate MWs for DER participation. These DER capability values may exceed nominated MWs for capacity resources because, in some cases, only partial capability may be offered. DER capability for economic registrations is captured as of 8/27/2017.

Figure 3: DR DER Registered MW Capability by Zone



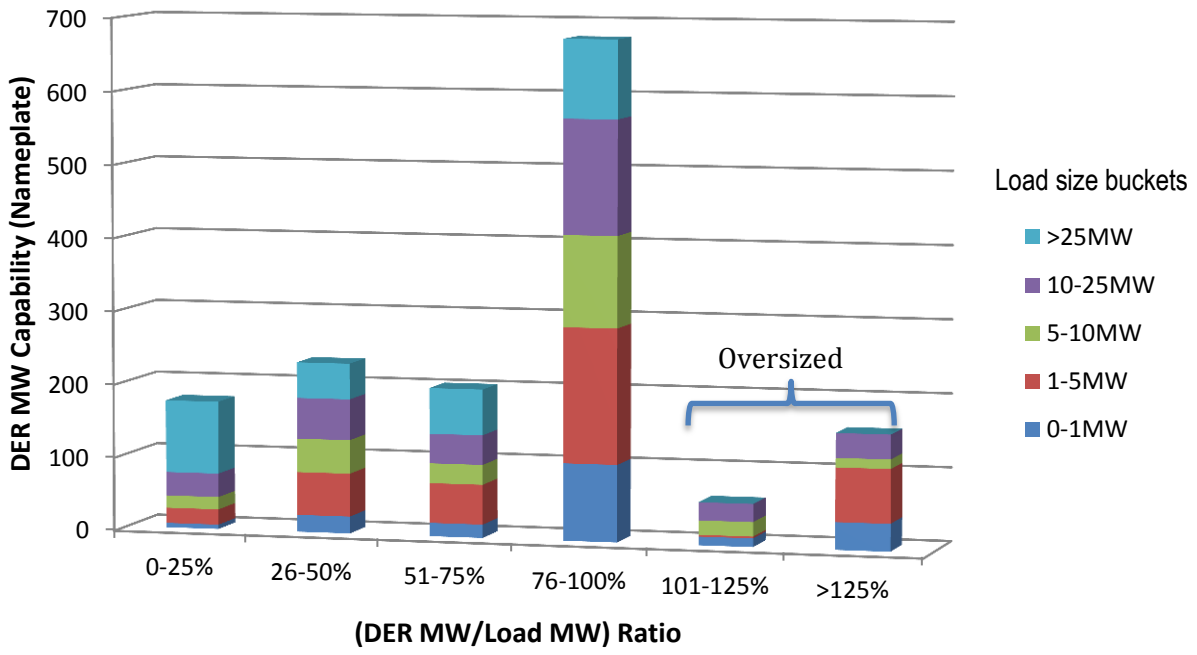
Note: Values are CSP reported nameplate MWs for DER participation. Locations that participate in both Load Management and Economic are included only once.

Figure 4: DR DER Registered MW Capability (17/18 DY) Fuel Mix with Behind the Meter Generation



Fuel mix for behind the meter generation that participates in Capacity Market as Demand Response for DY 2017/18 predominantly consists of diesel (74.4%) and slightly increased from the last delivery year natural gas (24.5%) which make up a combined 99% of the total fuel types.

Figure 5: DR DER Registered MW Capability by Size and ratio of Size/Load



DER Nameplate/PLC Ratio	Total Nameplate DER MWs by Customer Load (PLC)						%
	0-1MW	1-5MW	5-10MW	10-25MW	>25MW	Grand Total	
0-25%	6	21	17	32	99	175	*12%*
26-50%	23	59	46	56	49	233	*15%*
51-75%	18	54	27	40	62	201	*14%*
76-100%	105	184	125	156	107	677	*45%*
101-125%	12	2	19	24	0	57	*4%*
>125%	37	73	13	33	0	157	*10%*
Grand Total	201	393	247	342	317	1,499	***100%***

Figure 5 and associated Table display DER capacity (as represented by the nameplate MWs) broken down by the size of the peak load and the ratio of DER MW to the peak load MW. The ratio of DER MW output to peak load MW provides an indication of the size of the DER relative to peak load. For example, the 0-25% category represents DER capacity that is less than 25% of the peak load. Said another way, if the DER is activated it can only offset less than 25% of the peak load. Each bar on the graph represents the total amount of DR broken out by the size of the peak load (as represented by the PLC). Approximately 214 MW of the 1,499 total MW have DER nameplate capacity sized to cover over 100% of the peak load (157+57). Of that 214MWs, 156 MWs are DER with less than 10MW peak load (add 6 numbers in the columns with 0-10MW for two rows where DER/PLC ratio is >101%). In other words, the majority of oversized DERs are where the peak load is less than 10MW.

Note: "DER size" in this analysis is a DER nameplate capacity, "Peak Load" is a Peak Load Contribution which is typically based on the customers load during the PJM summer peak days. DER Size/Load ratio illustrates DER generation capability relative to the locations peak load.

Figure 6: DR DER Registered MW Injection Capability

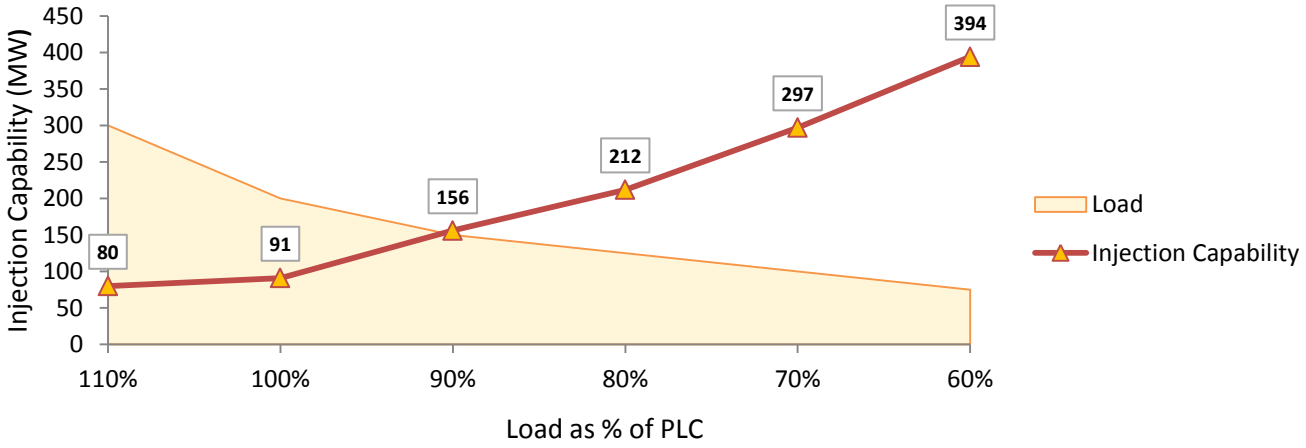
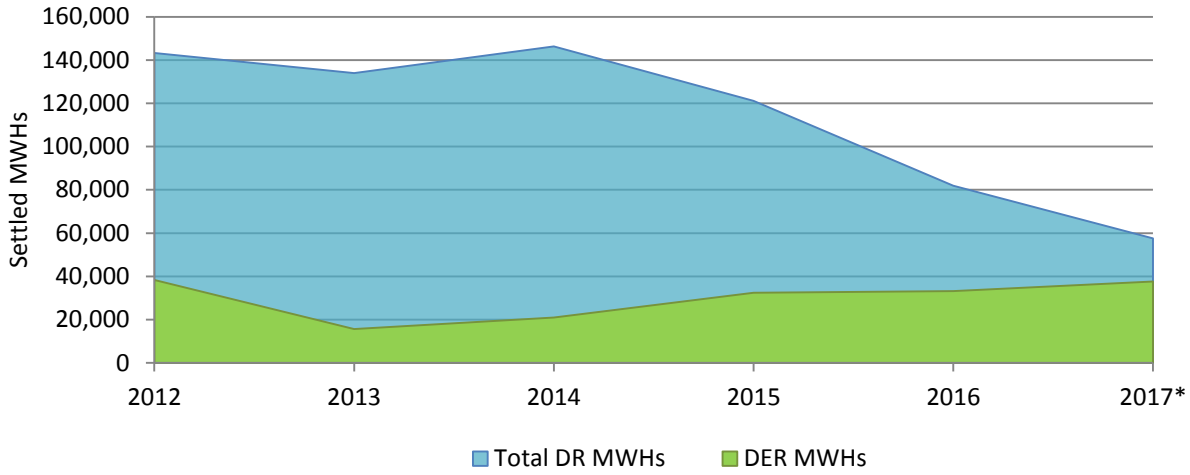


Figure 6 shows the DERs injection capability relative to the customers load. To illustrate this point we looked at cutomers' load as a percentage of their PLC. For example, if the load is at 80% of PLC, the total injection capability is approximately 212MW. The lower the load (as % percentage of PLC) the more DERs become oversized compared to their load and, consequently, the higher the injection capability. Majority of the weather dependent buildings are not loaded at the full PLC level most of the days in a year, thus increasing their potential to inject.

Note, that at 100% of PLC, 91 MW of injection capability in Figure 2 derives from the difference between Figure 6 oversized DER capability (214MW) minus PLC load at according sites (123MW).

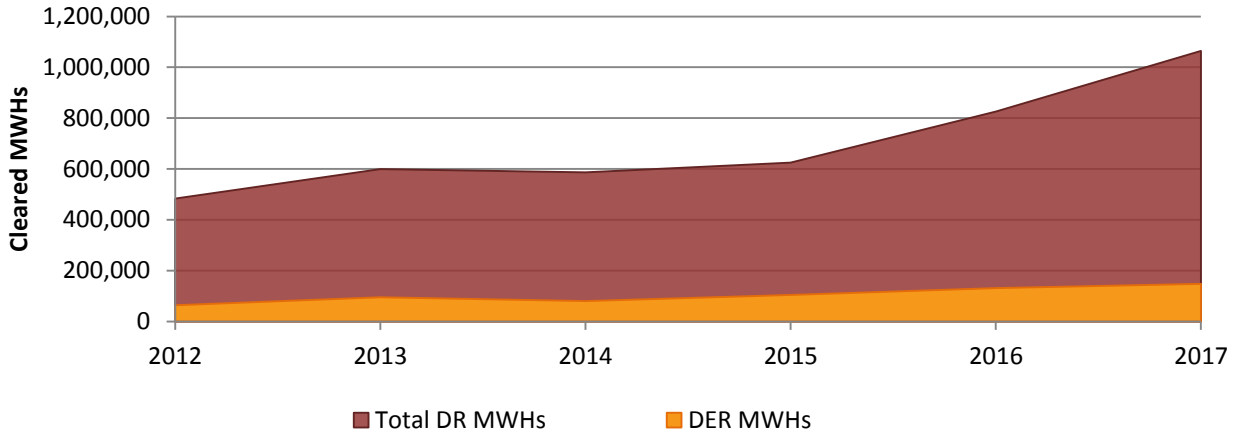
Figure 7: PJM Demand Response Economic Energy Settled MWhs Trend



While the total DR Economic Energy settled MWhs volumes declined over time, the share of DER participating as Demand Response gradually increased from 2013 level, thus, driving the DER/Total DR ratio up to 65% in 2017. This means the majority of economic DR activity in the energy market in 2017 came for DER.

*Note: 2017 settled MWHs number may increase when all settlements for events in November /December get confirmed. The final number will be reflected in 2018 DER report.

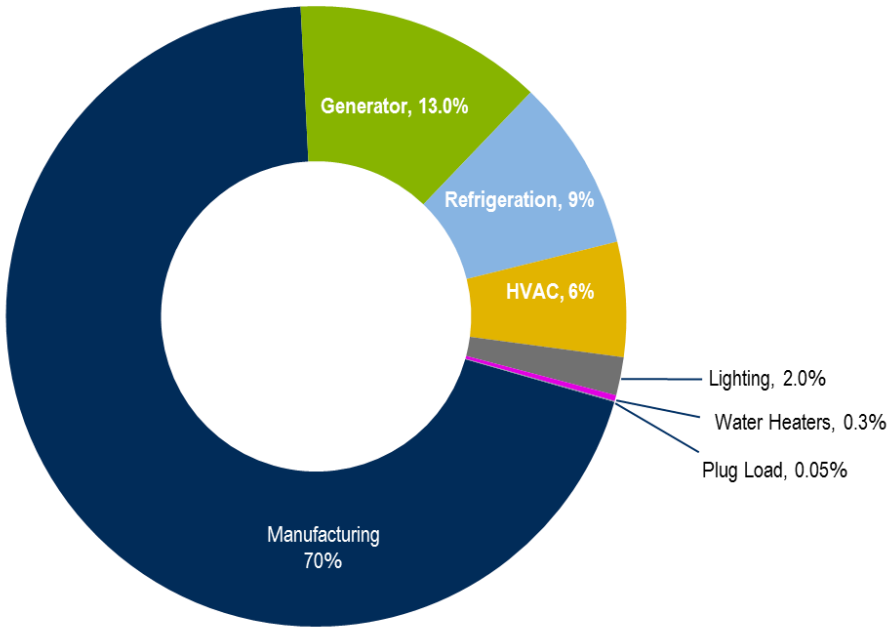
Figure 8: PJM Demand Response Synchronized Reserves Cleared MWhs Trend



DR Synchronized Reserves settled MWhs trend showed significant growth starting from 2015. DER share of Total DR decreased slightly from the previous year.

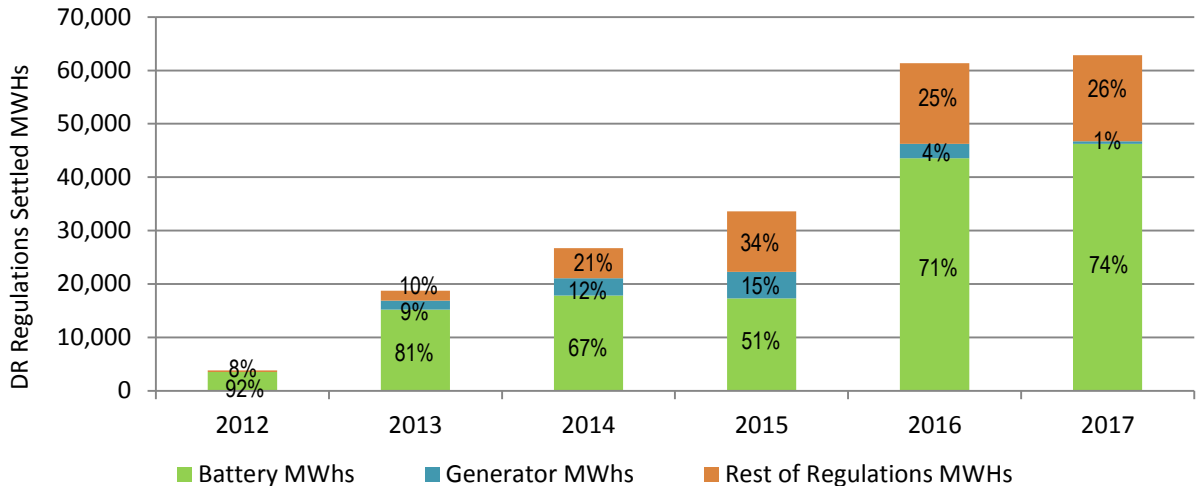
Note: PJM finding are based on extrapolation of DR capability by load reduction method submitted by curtailment service provider. PJM does not know what load reduction method was deployed in any given event.

Figure 9: 2017 PJM Demand Response Confirmed Synchronized Reserve Registrations Load Reduction Methods



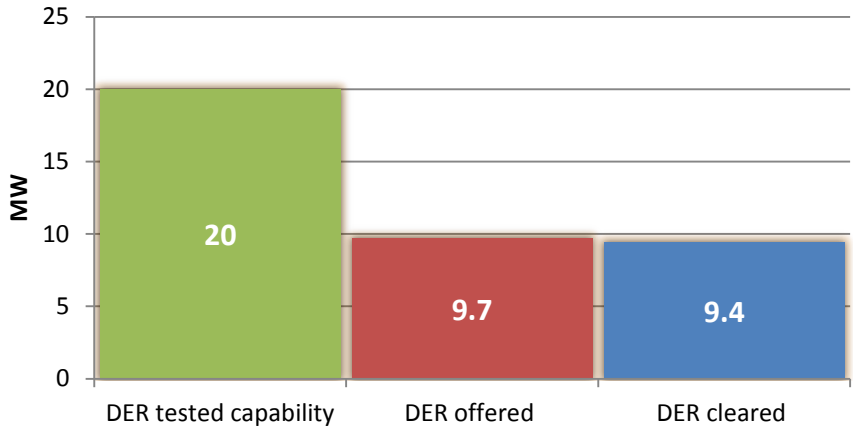
Behind the meter generators represent only 13% of total Synchronized Reserves participating as Demand Response while the a load reduction from the adjustement of a manufacturing process leads with 70%.

Figure 10: PJM Demand Response Regulation Settled MWhs trend for DER



Behind the meter battery storage provided 74% of the Demand Response in the regulation market in 2017. This is fairly consistent with amount in 2016.. Electrical water heaters provided 26% of the Demand Response in the Regulation market in 2017. At the same time behind the meter generators showed a decline from 15% share in 2015 to 1% in 2017.

Figure 11: 2017 DR DER Regulation MW participation



DERs offered volume in regulation market was at about 50% of the tested capability, and this is primarily because not all qualified resources have offered in 2017.