Demand Resource Eligibility

Eligibility WG #4 - July 13, 2017

Overview

Issue:

Should Demand Response, Energy Efficiency and Price Responsive Load participate on the supply side, demand side, both the supply and demand side, or neither, of the AB Capacity market?

Outline

- High level overview of Demand Response, Energy Efficiency, Price Responsive Demand
- Jurisdictional Review: Load Participation in Capacity Markets
- Demand not participating in the capacity market/ Demand participation on the supply side/ Demand participation on the demand side
- Benefits of Demand Participation in Capacity Market
- Properties of Demand participation as a Supply side resource
    - Establishing a baseline
    - Issues with baseline methodologies
    - Performance events and baselines
- Properties of Demand participation on the demand side
    - Establishing a baseline
    - During performance events
    - Participation examples

High Level Overview

Types of Demand Services in the Capacity Market

- "A **Demand Side Resource -** is the willingness of customers to respond to prices by reducing usage when the price of power, including energy and capacity, exceeds the value to the customer.
- This willingness can take the form of an agreement to reduce usage when the price (energy or capacity) is above a certain level or an agreement to reduce usage when the customer wants to respond to price."(1)

Service types:

Demand Response: load which reduces usage during times when system reliability may be threatened.

Energy Efficiency: involves the installation of more efficient equipment that achieves a permanent, continuous reduction in electric energy consumption at the consumer's site.

Price Responsive Demand: predictable change (a reduction as prices rise) in electricity usage in response to changing wholesale energy market prices.

(1)Barriers to Demand Side Response in PJM /Monitoring analytics/
http://www.monitoringanalytics.com/reports/Reports/2009/Barriers_to_Demand_Side_Response_in_PJM_20090701.pdf

High Level Overview

Two ways Load can participate in the Capacity Market

Supply-side Offer: The ability to reduce load during performance periods is offered as supply to the market. The target capacity requirement remains as determined by the AESO.

Demand-side Bid: Provides a schedule of capacity prices and quantities to be purchased on behalf of the specific load. Has the effect of reducing the demand as capacity is only purchased for the applicable load volume up until a specified price.

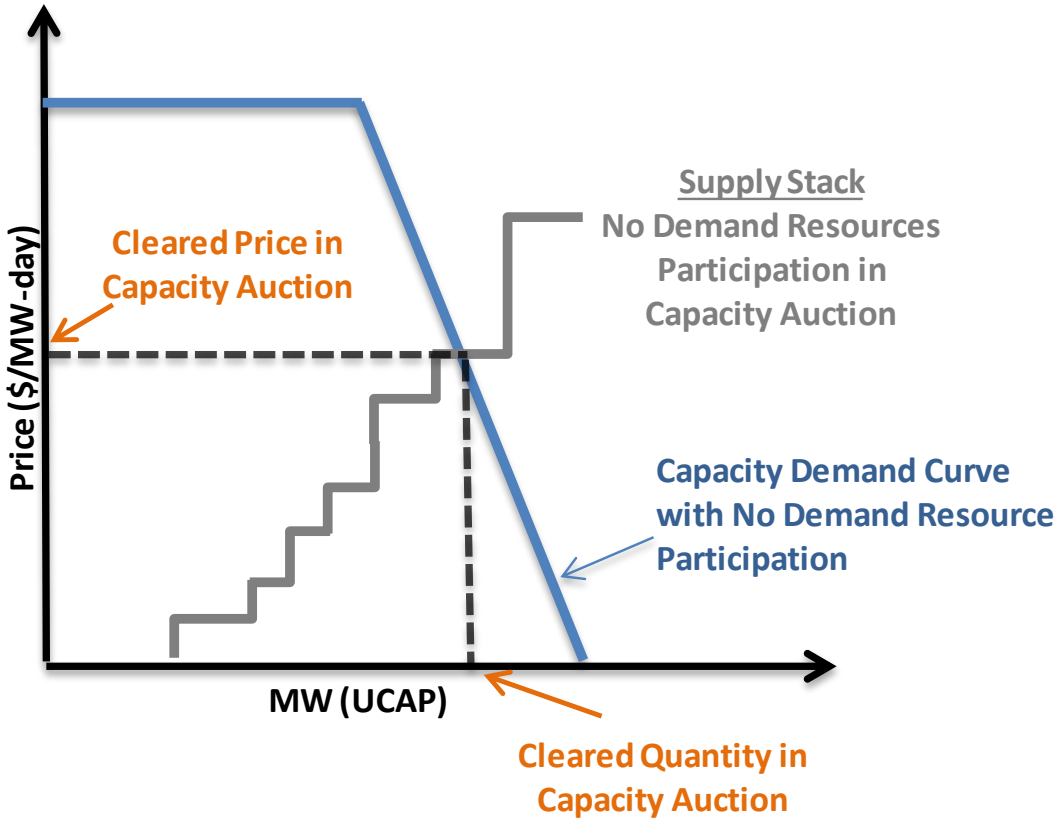
Load Participation in Capacity Markets: Jurisdictional Review

Capacity Markets		
Jurisdiction	**Supply-side participation**	**Demand-side participation**
PJM	Demand Response (DR)	Price Responsive Demand (PRD)
ISO-NE	Real-Time Demand Rsponse (RTDR)	
NYISO	Special Case Resources (SCR)	
MISO	Load Modifying Resource (LMR)	
Ireland	Demand Side Unit (DSU)	
UK	Demand Side Resource (DSR)	

Comparison Point: No Demand Participation in the Capacity Market

- Demand Curve for capacity in blue is determined by the AESO through the load forecast and reserve requirement study.
- Supply is represented by the gray step function.
- Auction clearing price and quantity is set by the intersection of supplier offer prices and the demand curve for capacity.

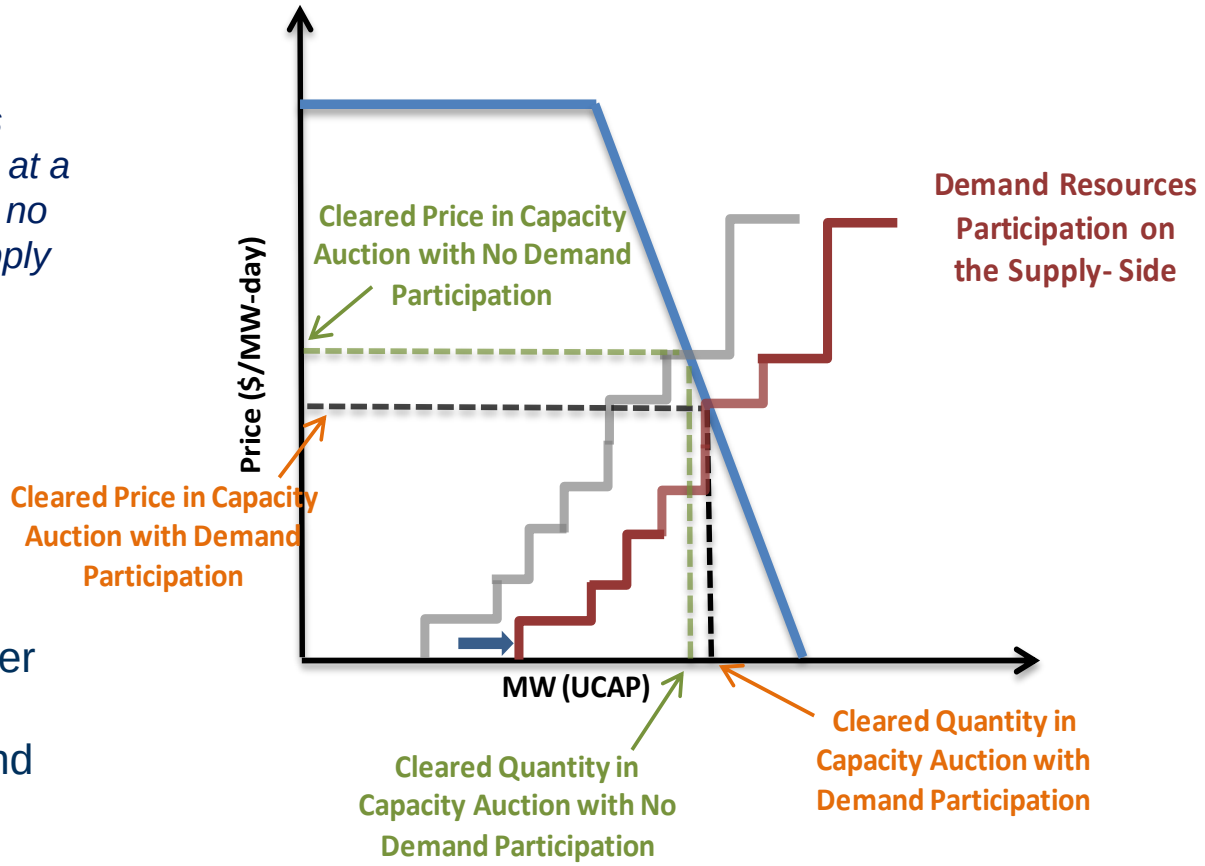
Pic 1: Stylized representation of no demand participation



Alternative: Demand Participation on Supply-Side

- Demand participates as a supply resource which has the effect of shifting the supply curve to the right as shown by the red supply curve.
  - *For ease of exposition, it is assumed demand offers in at a price of zero and there are no other changes to other supply offers.*
- Auction clearing price declines and the clearing quantity rises.
- Capacity clearing price is determined by the intersection of supplier offer prices (including demand resources) and the demand curve for capacity.

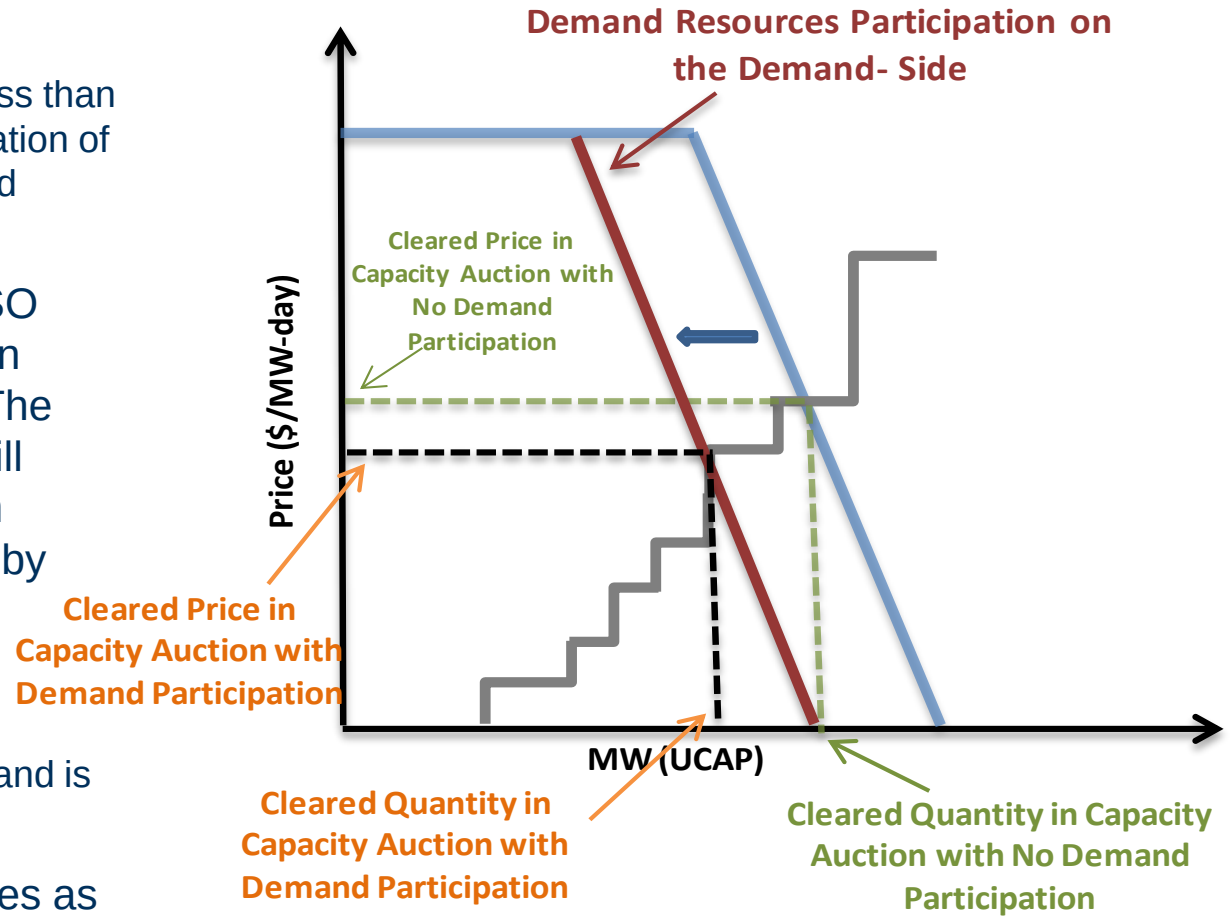
Pic 2: Stylized representation demand participation



Alternative: Demand Participation on Demand-Side

- Demand offers a bid schedule or prices and quantities of capacity it is willing to purchase.
  - The demand quantities are less than or equal to the capacity obligation of the load based on the demand curve.
- The effect is to shift the AESO determined demand curve (in blue) to the left (red color). The load has expressed that it will consume less during system emergencies than assumed by the AESO's demand curve.
  - For ease of exposition, it is assumed that the reduction in demand from the AESO demand is bid in at zero.
- Auction clearing price declines as does the quantity of cleared capacity.

Pic 3: Stylized representation of demand participation



The Benefits of Demand Resource Participation in Capacity Markets

- Market Benefits
  - Additional source of capacity at potentially lower cost which can displace higher cost resources.
  - Competition of additional resources reduces overall ability for the exercise of market power.
  - Provides an opportunity for customers to manage their electricity costs.
  - Potential smaller incremental resource size may be better able to match market growth.(2)
- Reliability benefits
  - Provides resource diversity to maintain system reliability.
  - Fast development cycle.

  In conclusion there are multiple benefits from encouraging demand participation in the capacity market.

(2)U.S Department of Energy/Benefits of Demand Response in Electricity Markets and Recommendations for Achieving them/https://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_Benefits_of_Demand_Response_in_Electricity_Markets_and_Recommendations_for_Achieving_Them_Report_to_Congress.pdf

Mechanics of Demand Participation on Supply-Side

- The AESO will procure capacity commitments through the auction on behalf of all loads with the same demand curve determined through the load forecast and reserve study process.
- In a market structure where demand resources participate as supply-resources - the supply of “demand reductions” are offered into the supply curve and are treated and compensated similarly to traditional generation assets. (Appendix 1 & 2)
- Demand resources that clear take on a capacity obligation and receive capacity payments determined by the capacity market clearing price.
  - Demand participants will still pay for their share of capacity as determined by the market clearing price and cost allocation methodology, but will offset a portion of their overall capacity expenditures through a revenue stream received for taking on the capacity obligation.

Potential Issues with Demand Participation on Supply-Side

Establishing a Baseline for a Demand Participant

- Under the demand on the supply-side model, a demand resource makes an offer to supply the ISO with a demand reduction, or what is often called “negawatts”, during capacity performance events.
- “Compliance with this obligation is measured by the difference between an assumed baseline consumption level and the supplier’s actual consumption during the performance event.
- The customer’s baseline consumption level is an administratively set value based on some model of how its consumption varies with weather conditions, system load, and other factors likely impact the customer’s electricity demand.
- Despite the best intentions of the designers of this mechanism, it is impossible for any entity to know precisely what the final consumer would have consumed during a given time period if it had not been called upon by the ISO to provide curtailment services.
- The customer’s meter can only measure its actual consumption during the demand reduction period.”(3)

(3)The California ISO’s Proxy Demand Resource (PDR) Proposal by F.Wolak, B.Hobbs, / May 1, 2009 http://www.caiso.com/239f/239fc54917610.pdf

Potential Issues with Demand Participation on Supply-Side

Moral Hazard Problem

- "This administrative process for setting the customer's "but for the performance event" level of consumption creates a moral hazard problem.
- Firms and customers have strong incentive to inflate the level of their baseline, because they are paid for the difference between this baseline and their actual consumption during a capacity performance event.
- For example, if a final consumer is paid 30 cents/KWh for demand reductions relative to a baseline, then this customer earns 30 cents times the number of demand response events for increasing its baseline by 1 KWh.
- The cost of any inflation to a loads baseline is borne by other ratepayers."(4)
- Generation units do not have an administratively set baseline. That is because the baseline level of production relative to which a power plant sells energy is zero.
- Compliance is measured by the difference between the actual output of the generation unit during the relevant delivery period and this baseline.

(4)The California ISO's Proxy Demand Resource (PDR) Proposal by F.Wolak, B.Hobbs, / May 1, 2009 http://www.caiso.com/239f/239fc54917610.pdf

Potential Issues with Demand Participation on Supply-Side

Economic and Reliability Asymmetry Example:

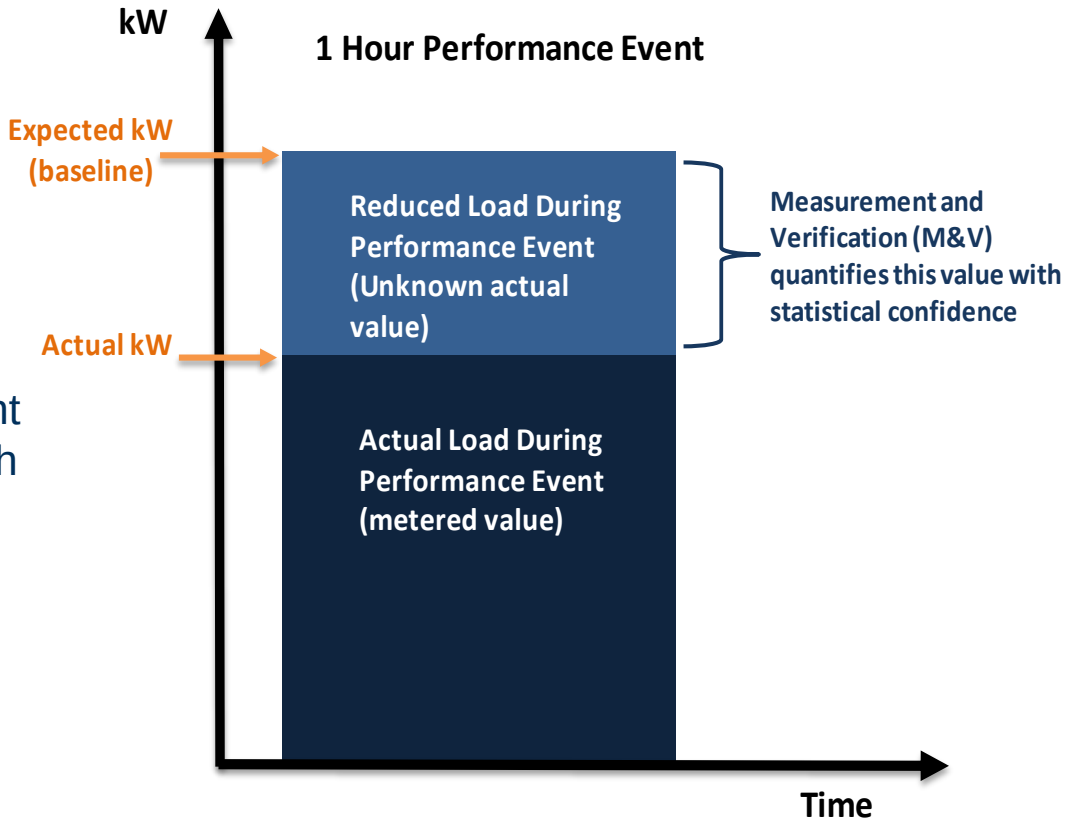
- "The use of an administratively set baseline for demand resources combined with a verifiable baseline of zero for generation resources together create an asymmetry in the contribution of these resources to system reliability and market efficiency."(5)
- In the energy market, when the AESO issues a dispatch to a 100 MW generator to provide 100 MWh of energy, compliance with the dispatch can easily be verified by reading the meter at site. If 100 MWh of energy was provided to the grid the unit is in full compliance with the dispatch.
- In contrast, for a demand resource participating on the supply side of the market, when the AESO purchases a 20 MWh of energy demand reduction, they have no way of verifying that 20 MWh less of energy was consumed as a result. The AESO can only measure actual consumption at consumer's site.
- The AESO has no way of verifying what the customers consumption level would have been if the load did not participate in the demand response program.
- An inaccurate baseline methodology, that systematically over-estimates the "business as usual" loads will over- value the reliability contribution of a demand resource during system reliability events.

(5)The California ISO's Proxy Demand Resource (PDR) Proposal by F.Wolak, B.Hobbs, / May 1, 2009 http://www.caiso.com/239f/239fc54917610.pdf

Potential Issues with Demand Participation on Supply-Side

- "Load drop is measured from a "baseline" of how much energy the customer would have been consuming were it not called upon to reduce its usage."(6)
- It is a challenge to set an accurate baseline for a load participant.
- "Many customers have a variable load, which means that they consume different amounts of electricity depending on such factors as the time of day, weather, and activities at the facility."(6)
- "For these customers, it can be difficult to demonstrate how much energy they would have been using but for their participation in the demand response program."(6)

Pic 4: Stylized representation of demand response

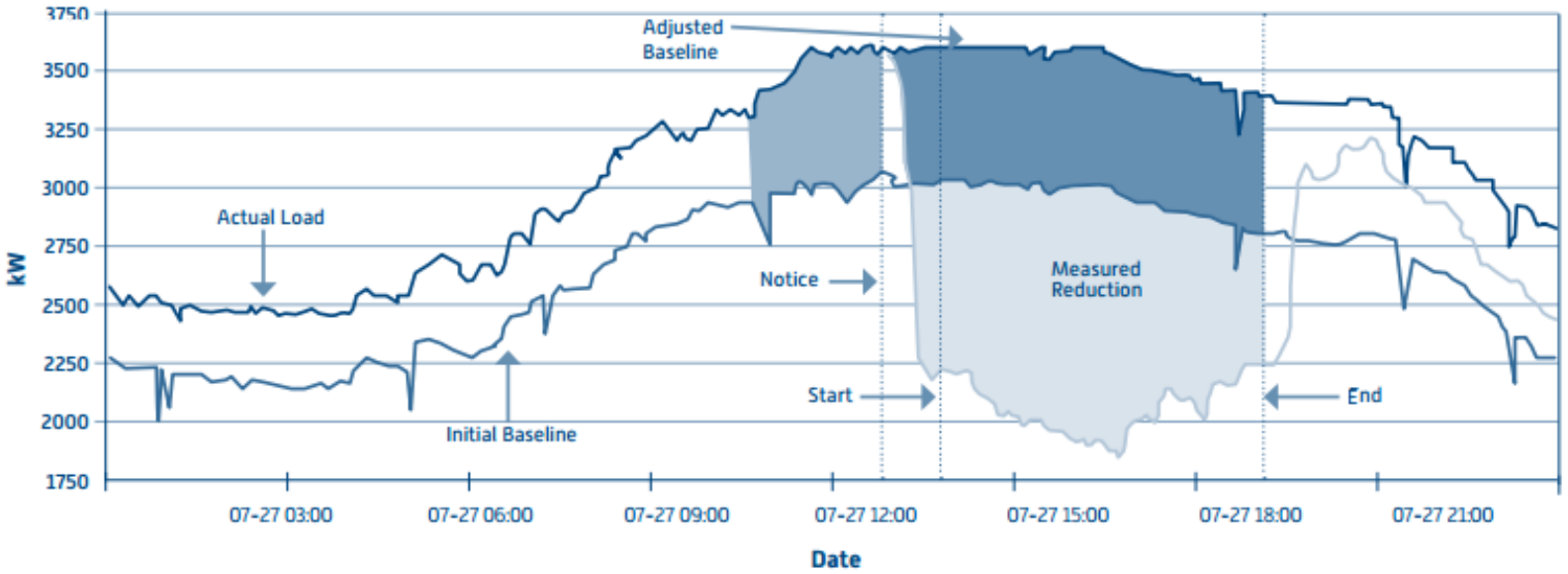


(6)The California ISO's Proxy Demand Resource (PDR) Proposal by F.Wolak, B.Hobbs, / May 1, 2009 http://www.caiso.com/239f/239fc54917610.pdf

Demand Participation on Supply-Side: EMV & Performance Events

PERFORMANCE OF A DEMAND RESOURCE DURING A PERFORMANCE EVENT (SUPPLY SIDE PARTICIPATION)

EXAMPLE: BASELINE AND PERFORMANCE MEASUREMENT FOR DEMAND RESPONSE ASSET



"Baseline Adjustment: The conditions on the event day, are often different from prior day conditions, especially for customers with weather-sensitive loads that increase during extremely hot or extremely cold conditions. Programs that are triggered by peak demand conditions or emergencies caused by generation outages often coincide with days of extreme weather, for this reason baselines are often adjusted." (7)

Evaluation, measurement, and verification (EM&V) of baseline has proven to be time consuming and subject to much controversy over the baseline calculation from which reductions are measured.

Graph taken from EnerNoc's white paper on baseline methodologies: EnerNOC, inc/2009/The Demand Response Baseline/White Paper/ Why Baselines Matter/Page 11

(7)EnerNOC/ the demand response baseline/white paper/page8/published 2011 https://library.cee1.org/sites/default/files/library/10774/CEE_EvalDRBaseline_2011.pdf

Mechanics of Demand Participation on Demand-Side

- Unlike with the supply side model, demand reductions will directly avoid some capacity costs, and need not “sell back” reductions for demand already purchased on its behalf through the AESO auction.
- This should be financially equivalent to the supply-side, two transaction option.
- Implied reduction is measured against the load’s procurement obligation in the capacity market, known in advance.
- Evaluation, measurement, and verification (EM&V) only requires reading the meter during a capacity performance period, to ensure the load bidding in its willingness to pay for capacity did not consume more than it bought on its behalf.
- No need for determining a counterfactual baseline consumption value to assess whether reductions were achieved.

Considerations of Demand Participation on Demand-Side

- **Establishing a Baseline for a Demand Participant**
- Demand side participation would avoid issues associated with administrative set baselines, by “soliciting the demand resource providers for the baseline through a bidding process.”(8)
- “The “self-declared” baseline approach thus enables the participating load to use their preferred methodology in estimating their baseline and adjust their bids, based on commercial considerations, when bidding into the capacity market.
- This will provide a demand resource greater flexibility in managing their load by bidding in only the load that can be curtailed during capacity performance events.”(9)
- This treatment is conceptually symmetrical to that of generators, who will be penalized if they do not comply to dispatch orders arising from their commitment to provide energy during performance events.

(8)The Brattle Group/prepared for Australian Energy Market Commission/International review of demand response mechanisms/Oct 2015

(9)Energy Market Authority - APPENDIX 1 TO THE EMA’S FINAL DETERMINATION PAPER ON IMPLEMENTING DEMAND RESPONSE IN THE NATIONAL ELECTRICITY MARKET OF SINGAPORE: RESPONSE TO FEEDBACK ON IMPLEMENTING DEMAND RESPONSE IN THE NATIONAL ELECTRICITY/EMA’s Response / MARKET OF SINGAPORE https://www.ema.gov.sg/cmsmedia/Electricity/Demand_Response/Appendix_1_DP.pdf

Demand Participation on Demand -Side: Performance events & baseline

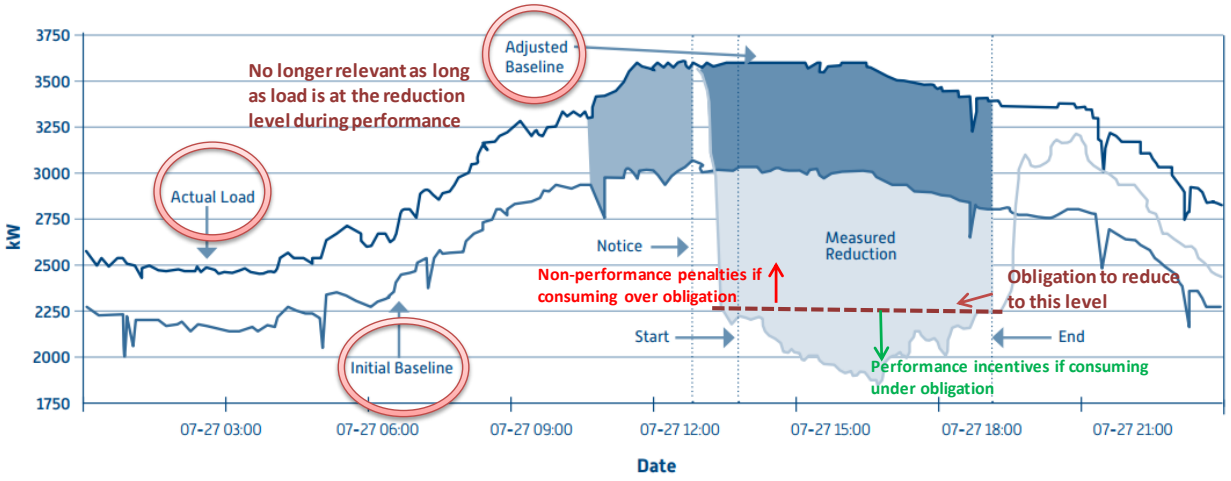
Demand Resource participating on the Demand- Side of the market:

There is no need for the ISO to create a theoretical baseline methodology.

To monitor performance during a performance event only need the load to provide the following:

1. The total size of the load participating in the market.

2. The size of the load reduction a demand participant has bid into the market. Load will be obligated to reduce to that level during a performance period.



Illustrative example above:

A load that is 3000 kW in size has submitted a bid into the capacity auction expressing that it will be willing to reduce load by 750 Kw during a capacity performance event, or in other words the load does not want to buy capacity for 750 kW (of its load) if the capacity market price is over a certain level. During a performance event the load will be expected to be at 2250 kw (3000kW – 2250kW) or else face penalties. The actual pre-event consumption of the load is irrelevant (no baseline adjustments are needed)

- Graph taken from EnerNoc's white paper on baseline methodologies: EnerNOC, inc/2009/The Demand Response Baseline/White Paper/ Why Baselines Matter/Page 11

Mechanics of Demand Participation on Demand-Side: Examples

Example 1

- Load with a forecast peak load obligation of 1,000 MW.
- The Load indicates that at any capacity price it will limit is consumption to 900 MW during emergency conditions. (Appendix 3)
- By default, at any clearing price, the load has committed to only consuming 900 MW when needed.

Example 2

- Load with a forecast peak obligation of 1,000 MW.
- The load indicates a willingness to limit hourly usage to 900 MW (from its forecast peak obligation of 1,000 MW) during an emergency event but only if the relevant capacity clearing price exceeds $200/MW-day.
- If the capacity clearing price is less than or equal to $200/MW day, the Load effectively is purchasing capacity to cover its forecast peak of 1,000 MW as the price is not worth reducing consumption.
- If the capacity clearing price exceeds $200/MW- day, the Load effectively purchases only 900 MW of capacity and obligates itself to only consuming 900 MW during capacity performance periods.
- Subject to capacity performance penalties if consuming more than 900 MW during capacity performance events.

Potential Benefits of Demand-side Participation

Monitoring Analytics, the Independent Market Monitor for PJM, has highlighted additional benefits of demand-side load-resource participation in the capacity markets.

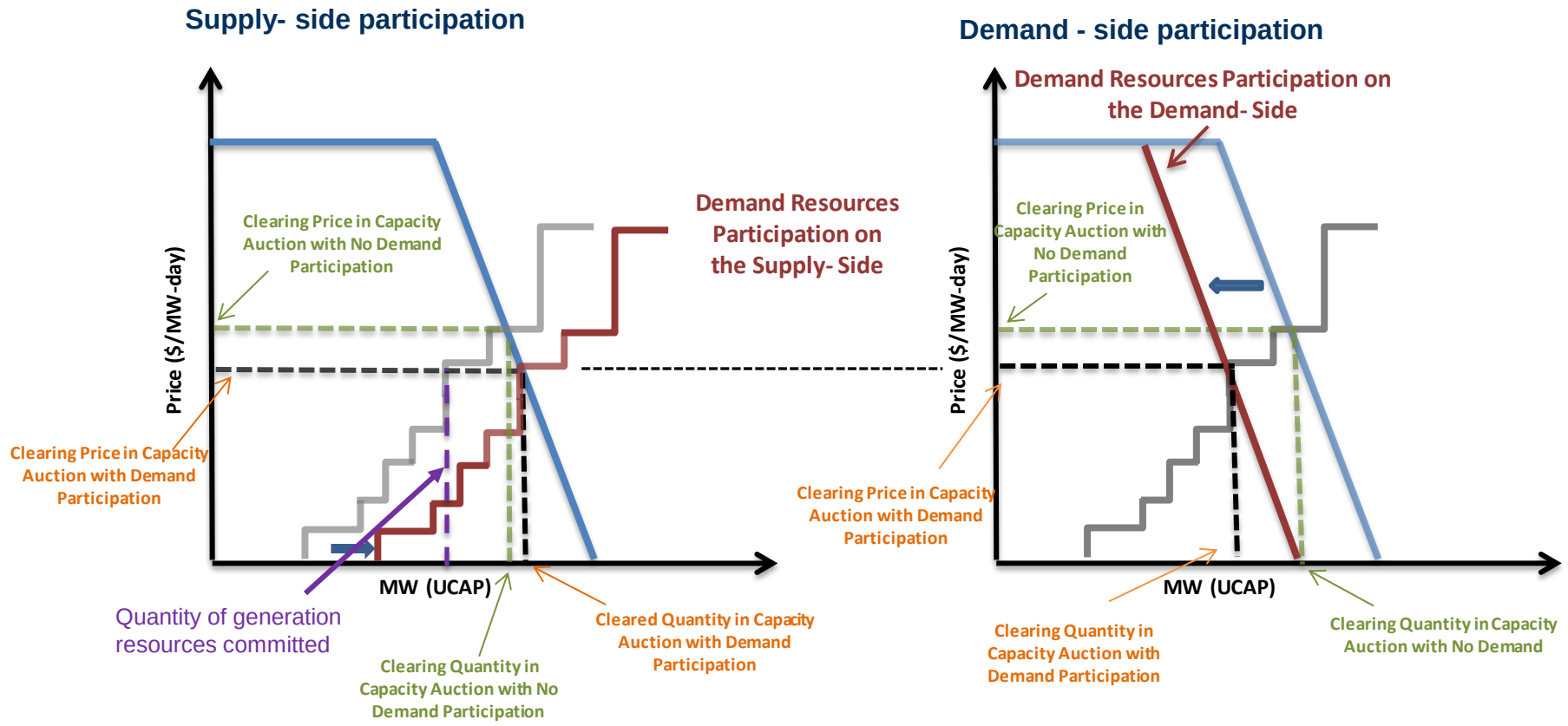
- Demand-side participation (PRD programs), by design, includes stronger compliance requirements, it allows demand to act as effective price responsive demand in both the capacity and energy markets.
- With correct design, demand-side participation, “would allow end use customers, without intermediaries, to see, react to and receive the direct benefits or costs” of changing consumption in response to energy and capacity price signals.(9)
- Current implementation of Demand-Side participation programs in PJM “is not an attractive option for load resources, relative to PJM’s other demand side programs (Supply-Side)….the design of other demand side programs (as Supply-Side resources) makes them artificially attractive”.(9)
- A demand-side participant, in the capacity market, will directly experience all the energy and capacity savings, as well as costs and penalties associated with their resources direct participation in the market.

(9)Price Responsive Demand/ The independent Market Monitor for PJM/ July 22, 2014
http://www.monitoringanalytics.com/reports/Reports/2014/IMM_Price_Responsive_Demand_ER11-4628-000_20140722.pdf

Demand Response Participation Supply- vs. Demand-Side: Equivalence and Differences

Reduction in capacity prices and quantity of generation resources committed will be equivalent in both scenarios

Pic 5: Stylized representation of demand response



Demand Response Participation Supply- vs. Demand-Side: Equivalence and Differences

Equivalence:

- In both cases, the reduction in price is the same relative to no demand participation.
- The amount of actual supply (generation) resources committed should be the same.
- The cleared quantity with demand participating on the demand-side is the amount of generation resources.
- The cleared quantity less demand clearing as a supply resource equals the amount of generation cleared (in purple in the previous slide).

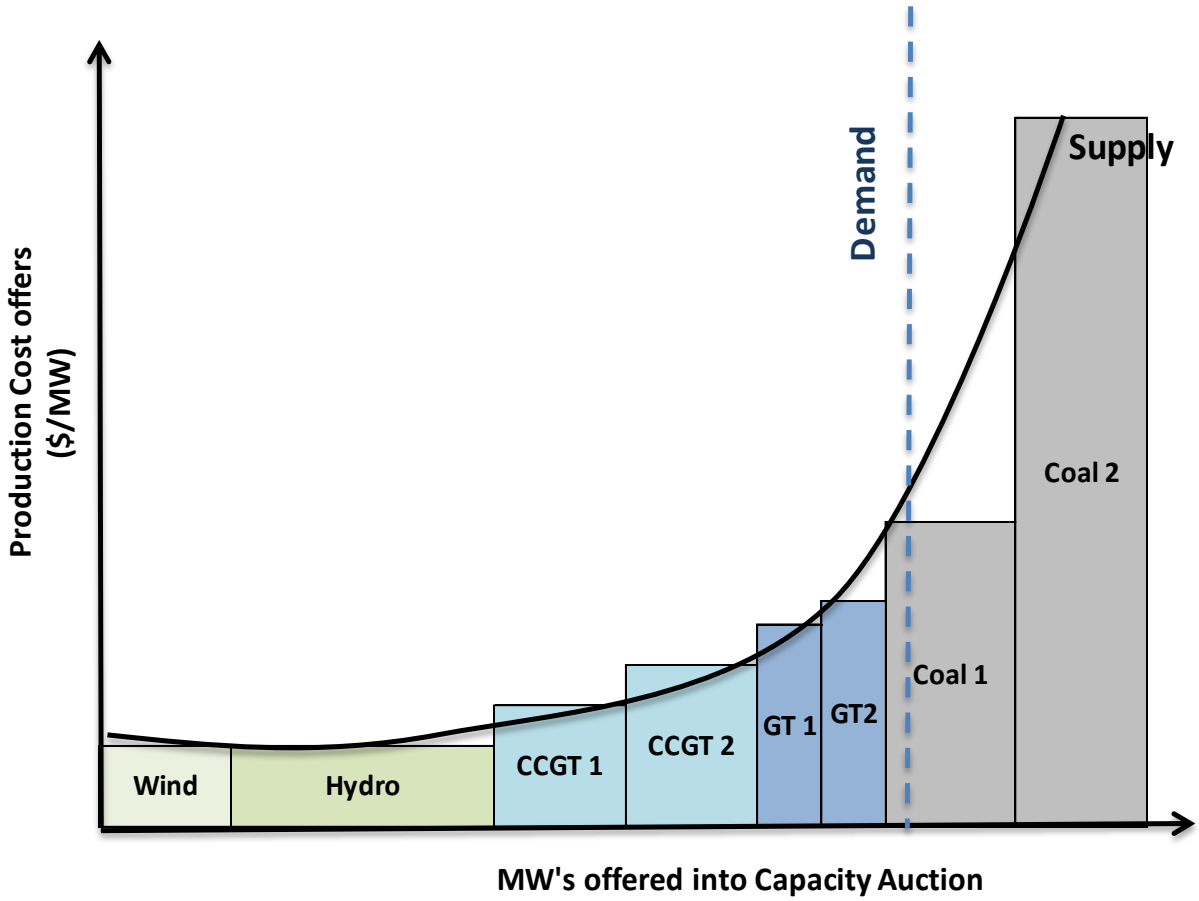
Differences:

- Cleared quantities are different due to treatment of demand on supply or demand side of the market.
- Certainty with what we are getting on demand side, not clear that the quantities can be verified with supply-side participation due to baseline issues. Supply-side requires baseline adjustments while the self-declared demand-side approach does not.

Appendix 1

ILLUSTRATIVE: COMPETITIVE CAPACITY MARKET WITHOUT DEMAND RESOURCES

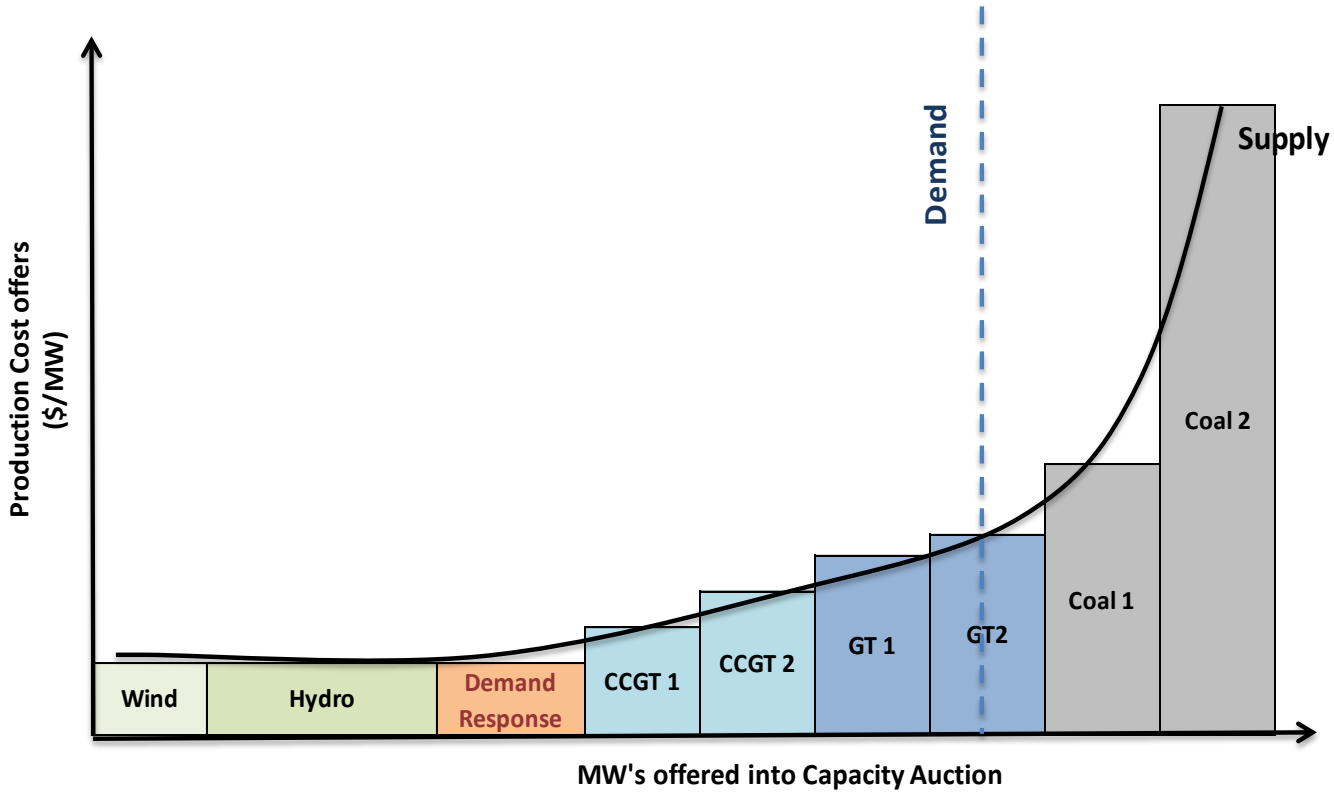
Pic 6: Stylized representation of the demand participation



Appendix 2

EFFECT OF ADDING DEMAND RESPONSE TO CAPACITY AUCTION ON SUPPLY SIDE

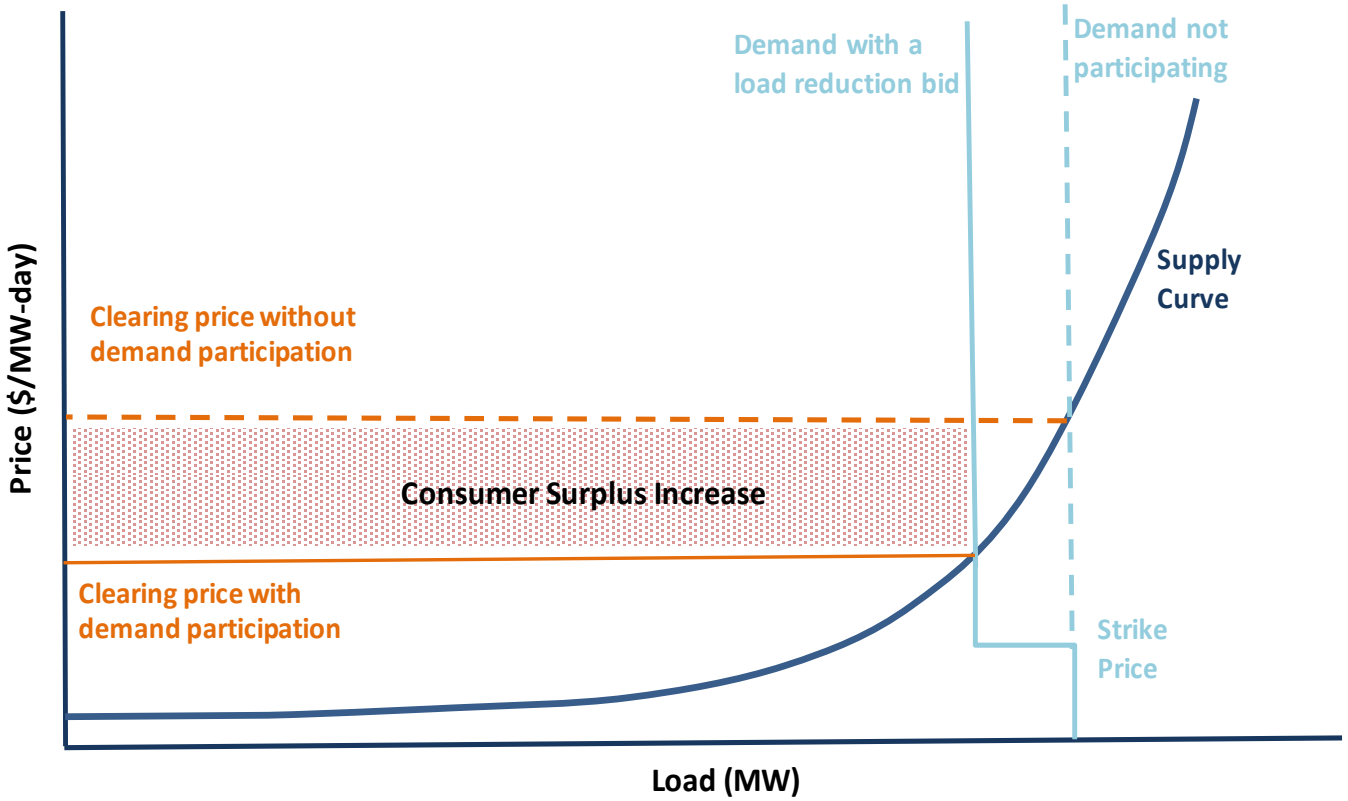
Pic 7: Stylized representation of the demand participation



Appendix 3

EFFECT OF ADDING DEMAND PARTICIPATIOM TO CAPACITY AUCTION ON DEMAND SIDE

Pic 8: Stylized representation of the demand participation



Singapore demand response mechanism incentive illustration/ prepared for Australian Energy Market Commission by The Brattle Group/ graph converted for AB capacity market needs by the AESO

References (*)

Barriers to Demand Side Response in PJM /Monitoring analytics/

http://www.monitoringanalytics.com/reports/Reports/2009/Barriers_to_Demand_Side_Response_in_PJM_20090701.pdf

The California ISO's Proxy Demand Resource (PDR) Proposal by F.Wolak, B.Hobbs, / May 1, 2009

http://www.caiso.com/239f/239fc54917610.pdf

Iowa Law Review/ Bypassing Federalism and the Administrative Law of Negawatts / S.B. Jacobs

https://ilr.law.uiowa.edu/print/volume-100-issue-3/bypassing-federalism-and-the-administrative-law-of-negawatts/

Energy Market Authority - APPENDIX 1 TO THE EMA'S FINAL DETERMINATION PAPER ON IMPLEMENTING DEMAND RESPONSE IN THE NATIONAL ELECTRICITY MARKET OF SINGAPORE:

RESPONSE TO FEEDBACK ON IMPLEMENTING DEMAND RESPONSE IN THE NATIONAL ELECTRICITY MARKET OF SINGAPORE

https://www.ema.gov.sg/cmsmedia/Electricity/Demand_Response/Appendix_1_DP.pdf

Energy Efficiency Towards the End of Demand Growth/F.P. Sioshansi

EnerNoc, INC/White Paper/ The Demand Response Baseline

https://www.naesb.org//pdf4/dsmee_group3_100809w3.pdf

https://library.cee1.org/sites/default/files/library/10774/CEE_EvalDRBaseline_2011.pdf

When it comes to Demand Response, is FERC its Own Worst Enemy? /Bushnell, James, Hobbs, Benjamin, Wolak, Frank A.

https://fsi.fsi.stanford.edu/sites/default/files/when_it_comes_to_demand_response.pdf

Price Responsive Demand/The Independent Market Monitor for PJM/ Monitoring analytics 2014

http://www.monitoringanalytics.com/reports/Reports/2014/IMM_Price_Responsive_Demand_ER11-4628-000_20140722.pdf

Thank you