THE DEMAND RESPONSE ROADMAP FOR THE PJM REGION

Demand Response as a Supply Resource

Endorsed by the Mid-Atlantic Distributed Resources Initiative (MADRI) in 2007

Introduction

PJM held a symposium on demand response (DR) in May 2007 that was attended by a broad mix of stakeholders and subject matter experts. One of the most prominent themes to emerge from the symposium was the need for coordination between retail and wholesale markets in order to increase demand response participation in PJM's markets. The participants at the PJM Symposium on Demand Response identified nine 'top priority opportunities.' These are shown in the next slide.

Introduction

1	A regional approach to the development of standardized platforms, communication protocols, investments in enabling technologies, and wholesale-retail DR integration issues
2	New retail rate structures that better reflect wholesale market pricing strategies
3	Pricing that captures the full value of DR and mechanisms for customers and service providers to get access to all relevant revenue streams
4	Direct load control for all residences, perhaps through state legislation, and modification of building codes for new residences so that they include specifications for technologies that accept/address dynamic pricing signals
5	Advanced metering infrastructure (AMI) available to all customers who want it and price responsiveness with little or no manual intervention
6	Exposure for all customers to hourly wholesale prices
7	Establishment of quantitative (MW) regional goals for DR
8	Adjustment of the 25% cap that currently exists in PJM's synchronous reserves DR program
9	Full responsibility taken by PJM for metered data and calculations used in determining customer baseline loads (CBL)

Development of the Demand Response Roadmap

The symposium participants also emphasized the need to properly allocate responsibility for addressing some of these opportunities. In essence, some are areas in which the retail market should take a leading role, some are areas in which the wholesale market must take a leading role, and others required a joint retail/wholesale commitment.

The combination of priority opportunities overlaid by the mix of retail and wholesale responsibilities lead to suggestions for the development of a coordinated plan, a Demand Response Roadmap, to guide the way.

The Roadmap is organized into a series of functional areas which collectively form the basis for creating a DR roadmap.

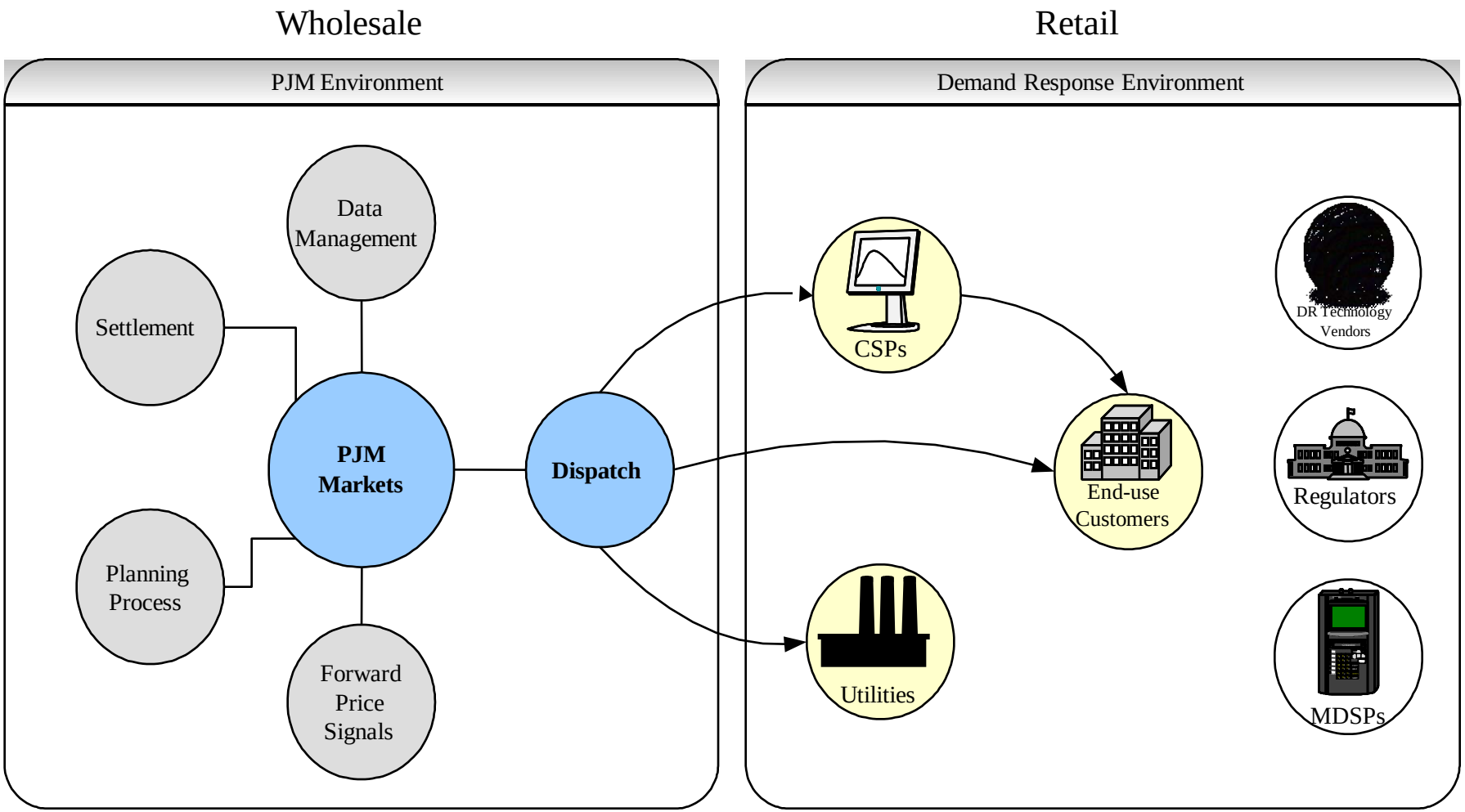
* Dispatch of demand resources
* Data management
* Settlement of demand response activity
* Demand response in the planning process
* Forward price signals for demand response

Organization of the Demand Response Roadmap

Each section includes a table that identifies items and actions for the retail environment and for the wholesale environment. This material was assembled from a variety of sources. These include MADRI's initiatives, recommendations from PJM Symposium on Demand Response, state commission DR working groups, PJM's Demand Side Response Working Group and the NARUC/FERC demand response collaborative.

The MADRI Steering Committee has endorsed this Demand Response Roadmap as the starting point for coordinated retail/wholesale efforts to grow DR market participation.

Figure 1. Coordination of Dispatch Activities



Activities Table 1. Dispatch Considerations by Market

WHOLESALE	RETAIL
1. Enable Real Time availability for both economic and emergency Demand Resources (2009) 2. More reliable economic demand resources in Real Time (on-going) 3. Real-time Unit Dispatch System dispatch of DR (2007) 4. Implement nodal dispatch of Demand Resources in Real Time and for emergencies by identifying nearest 115kV and above pnode name (partial) 5. Maintain a voluntary, self-schedule Real-Time Energy Market option for Demand Resources (on-going)	1. DR that is dispatchable based on price and location 2. Region-wide measurement and verification protocols 3. Decoupled distribution rates or alternative for distributor to recover revenues lost as the result of DR 4. Critical Peak Pricing/other retail rates more aligned with LMPs 5. Retail rate design that provides customers with real savings opportunities (not revenue neutral) 6. AMI deployed 7. Standard interconnection standards and rules for distributed generation

Figure 2. Coordination of Data Management

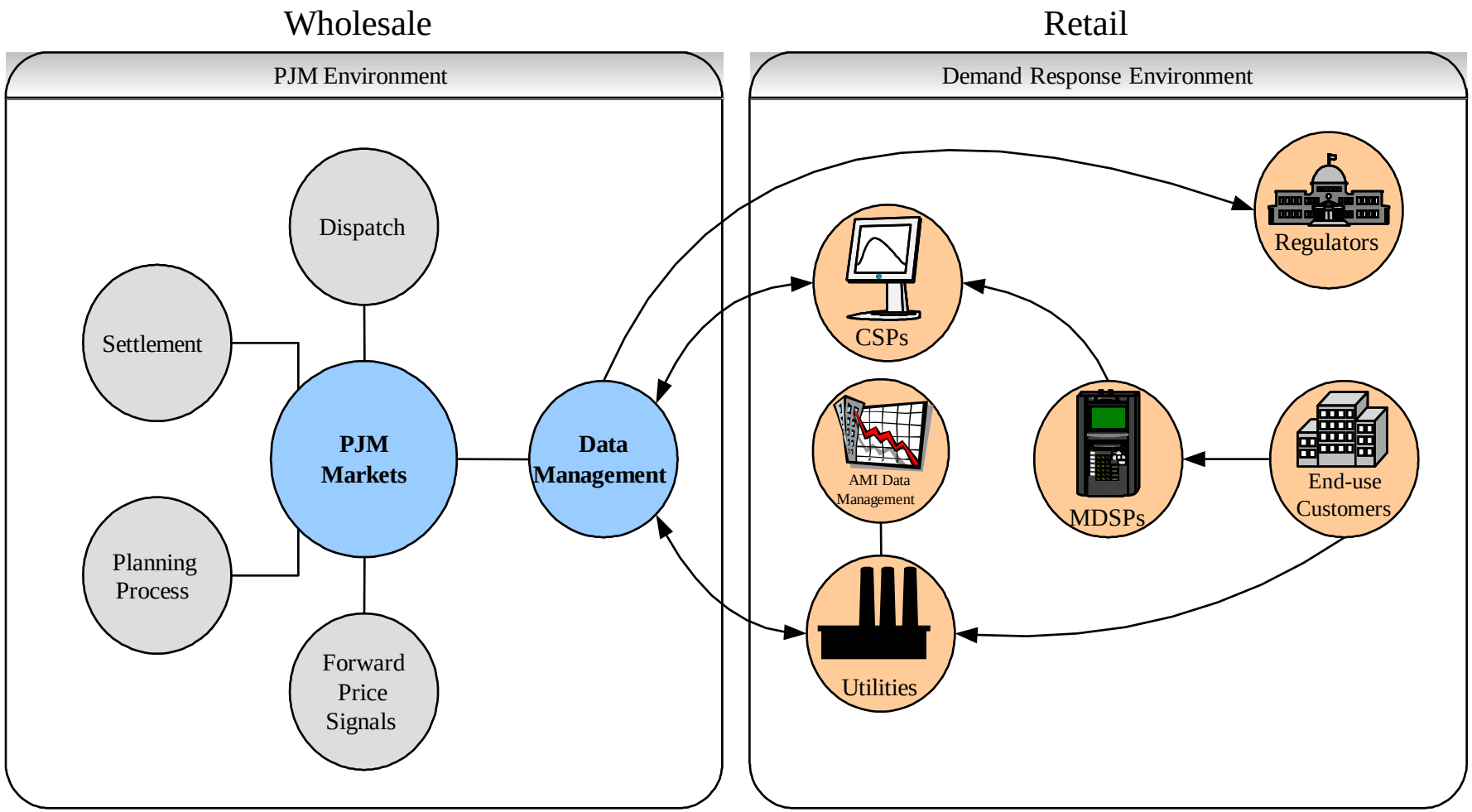


Table 2. Data Management Considerations by Market

WHOLESALE	RETAIL
1. Direct data management by PJM a) Enable the aggregation of demand resources (2009) b) Consider proper interface between eLoadResponse and eMarket (2009) c) Load Response application enhancements including hourly availability of DR and speedier settlements (2009) d) Electric distribution company (EDC) provide directly key customer information 2. Management of data provided directly to PJM electronically a) Develop meter data service provider (MDSP) certification standards (2009) b) Determine appropriate communication technologies for meeting business need to obtain real market data 3. Status quo provision of data to PJM by curtailment service providers (CSPs) for subsequent review by utilities (EDCs and LSEs) [on-going]	1. End-use customer and authorized agents unambiguous right to meter data at reasonable cost 2. Metering devices requested by CSP on behalf of customers installed within 10 business days 3. Meter data directly accessible by PJM and CSP at least daily 4. Standard electronic data interchange (EDI) transactions developed to accommodate full market participation by Demand Resources 5. Minimize stranded cost of deployment 6. Shorter more appropriate depreciation rates for meter data management software

Figure 3. Coordination during the Settlement Process

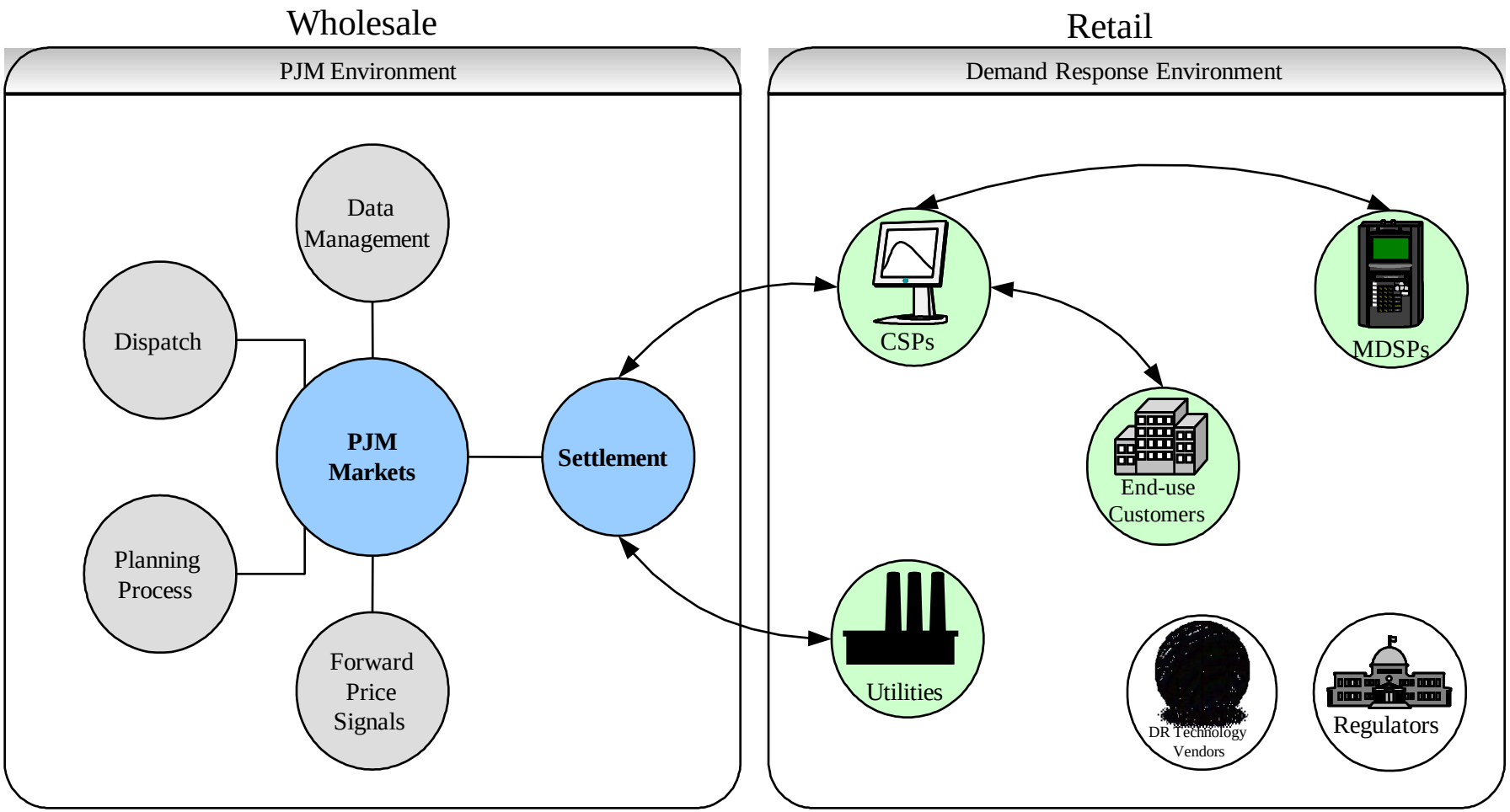


Table 3. Settlement Considerations by Market

WHOLESALE	RETAIL
1. Speed up settlement for demand reduction (2009)	1. Codification of end-use customer's right to sell unused electricity
2. Automate the settlement adjustment process (2009)	2. Codification of customer baseline (CBL) calculation and rules
3. PJM calculates the CBL (2009)	3. Cost effective and timely (daily) access to meter data
4. PJM direct access to meter data based on regional standards for communications protocols	4. No longer need to routinely review and settlement (spot checks to verify MDSP standards maintained)

Figure 4. Coordination during the Planning Process

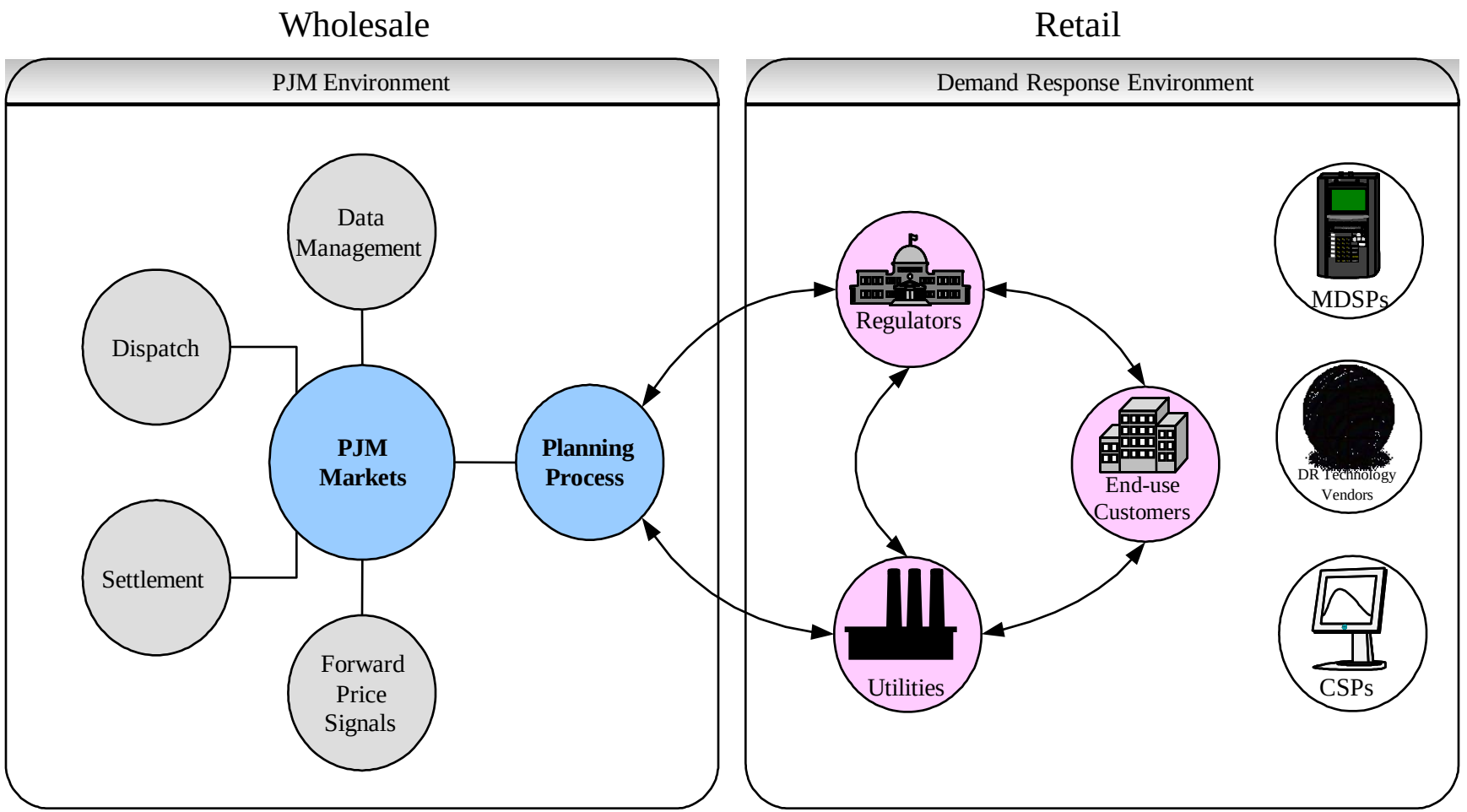


Figure 4. Planning Process Considerations by Market

WHOLESALE	RETAIL
Integrate DR into RTEP and Economic Transmission processes by: 1. Publishing DR needed as temporary/permanent substitute for transmission enhancements (2007) 2. Developing queue for Planned DR 3. Including planned DR in annual update of the Load Forecasts (2007)	1. Product tests to measure system impact value and customer acceptance before broad deployment 2. Update load data that reflects the impact of Demand Resources including planned DR 3. Implement resource procurement strategy that includes economically viable DR 4. Build infrastructure for quick to market DR

Figure 5. Coordination of Forward Price Signals

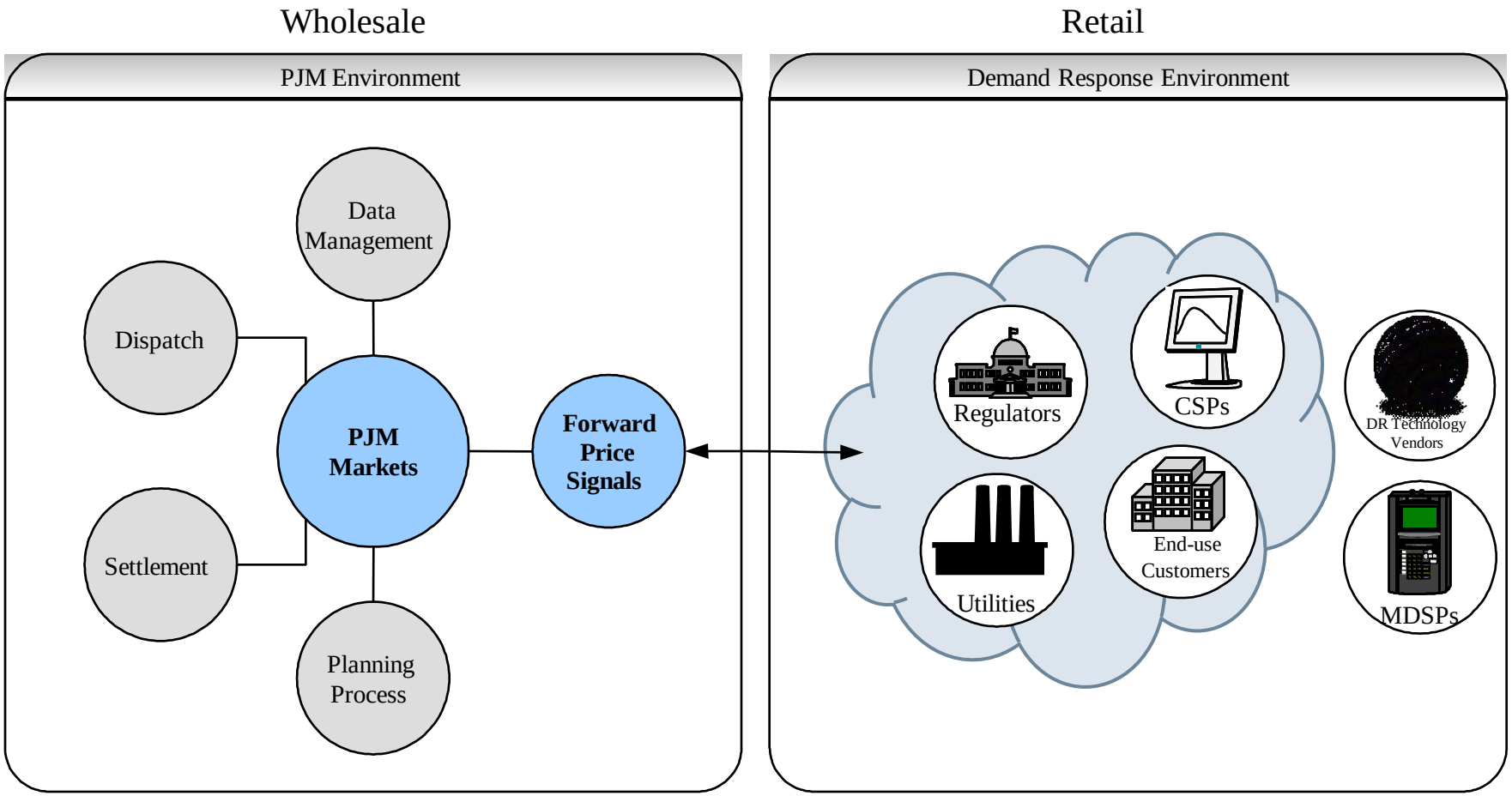


Table 5. Forward Price Signals Considerations by Market

WHOLESALE	RETAIL
1. Reliability Pricing Model for emergency/reliability (2007) 2. Capture maximum forward capacity market value for energy efficiency (2009)	1. Establish a regional (MADRI) DR goal of 3 percent 2. RFP for “virtual peaking capacity” 3. Portfolio standards with a requirement for demand resources

Demand Response Participation on the Load Side of the Market

Price Responsive Demand
(DR 3.0)

"Price Responsive Demand can be characterized as a third generation of demand response or DR 3.0. First generation demand response would include interruptible rates and direct load control, and RTO Demand Response programs would be a second generation of demand response."

Commissioner Paul Centolella
Ohio Commission 2009

"Dynamic pricing offers customers new options to manage their utility bills, as well as the potential to reduce wholesale power costs as customers respond to high peak prices."

Commissioner Rick Morgan
DC Commission in the March 2009 Public Utilities Fortnightly

"The integration of Price Responsive Demand in the wholesale and retail markets will increase the efficiency and robustness of the marketplace for electricity."

Andrew L. Ott
Sr. V.P. Markets, PJM 2009

Figure 1. Impact of Price Responsive Demand on Dispatch

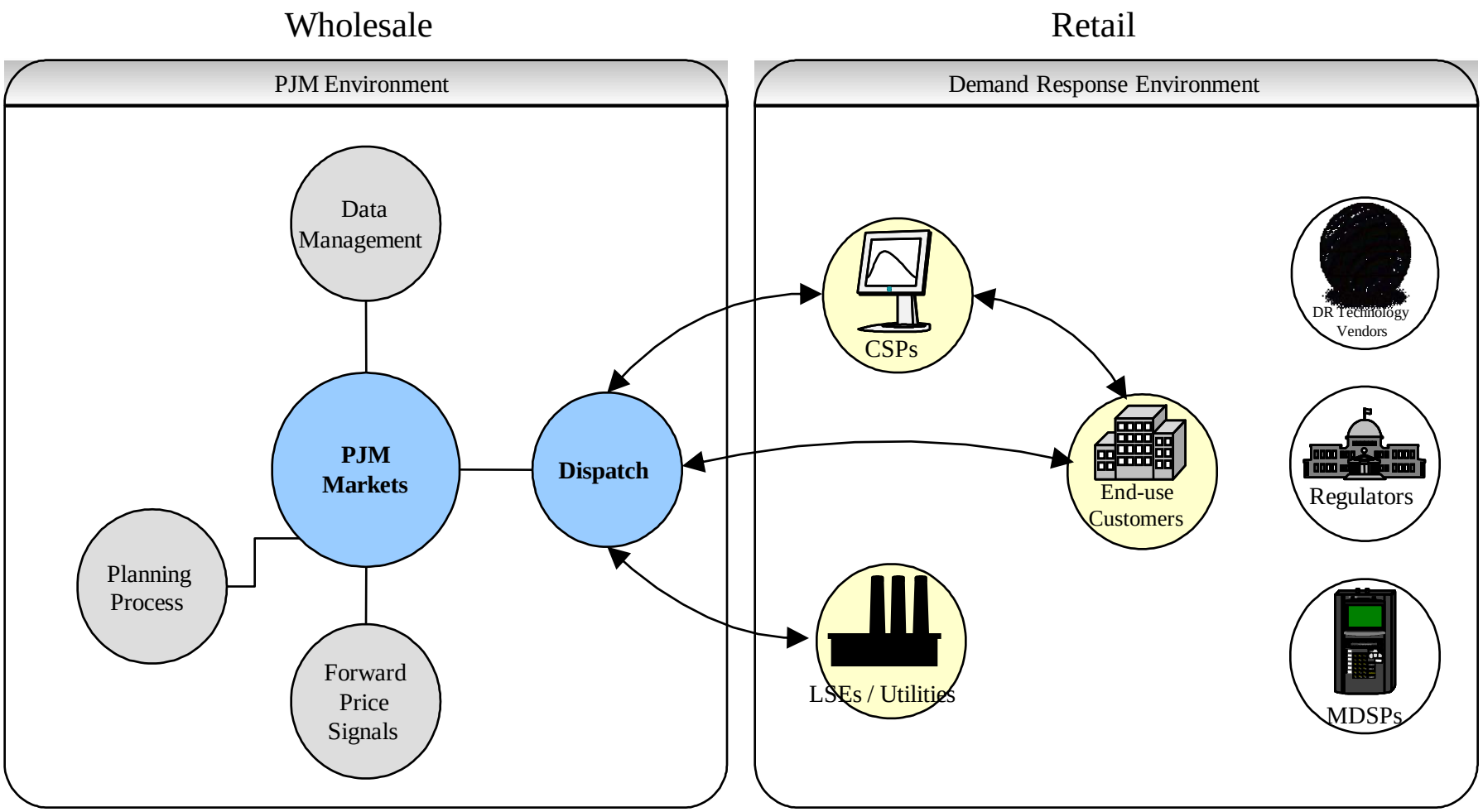


Table 1. Load that Responds Predictably to Dynamic Prices

WHOLESALE	RETAIL
1. Implement a look-ahead load forecast that includes the expected locational load level as a function of price that is documented in a Forecast Demand Response Curve 2. Revise Unit Dispatch System to take account of load levels as a response to price 3. Implement Scarcity Pricing through an Operating Reserve Demand Curve framework so that: a) Price impacts of varying quantities of operating reserve shortage are transparent b) Account for Scarcity Pricing revenues paid to capacity resources c) Load reduction capability can be deployed in response to price: i. before emergency actions ii. coincident with emergency actions	1. Retail rates that change daily or hourly in response to LMPs or other Energy Market conditions 2. Metering capable of recording usage on an hourly or sub-hourly basis: a) Competitive Supplier access b) Curtailment Service Provider access 3. Billing system capable of accurately and timely billing of dynamic retail prices 4. Enabling cost effective technology that: a) Communicates price signals b) Automates response c) Incorporates standards developed by the National Institute of Standards and Technology (NIST) process 5. Smart grid and dynamic prices education for policy makers, regulators and consumers 6. Measurement and reporting of resulting changes in load

Figure 2. Coordination of Data Management

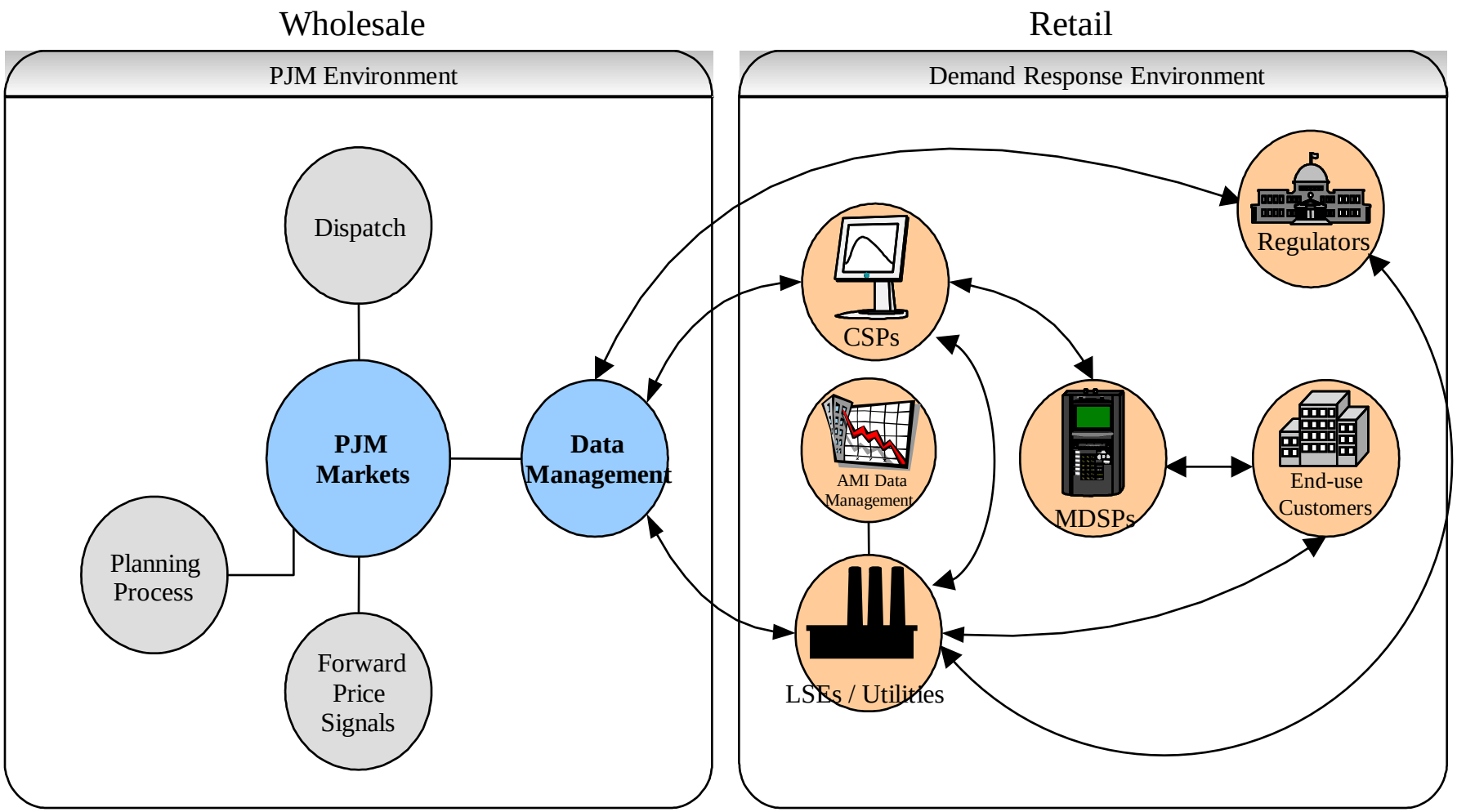


Table 2. Measurement, Quantification and Reporting of Price Responsive Demand

WHOLESALE	RETAIL
1. Create Forecast Demand Response Curve for each zone (aggregate or node) using price / quantity data provided by Load Serving Entities. Locational granularity of price/quantity data must be determined 2. Use Forecast Demand Response Curves: a) to improve accuracy of load forecast and system dispatch both day-ahead and in real-time b) to inform the planning process and capacity procurement 3. Pending development of an integrated forecasting model, PJM will use price elasticity data from pilots and accepted statistical tools, including the Pricing Impact Simulation Model (PRISM), to develop forecasts for actual Price Responsive Demand.	1. Quantify and report actual Price Responsive Demand by location in a consistent and accurate manner 2. Provide price elasticity data obtained through on-going and recently conducted pilots in PJM (See, for example, Residential Smart Metering Pilot – PowerCentsDC in PEPCO, Smart Energy Savers Program pilot in BG&E, Energy Smart Pricing Program pilot in ComEd, AMI pilot program in PPL, myPower Pilot Program in PSE&G, AMI pilot program in PECO, and South Bend, Indiana Pilot in AEP) 3. Electric Distribution Company provides the LSE with the end-use customer's actual hourly usage rather than the customer class average so that: a) LSE supplies the actual aggregated load of its end-use customers in each hour b) LSE can offer dynamic prices to customers and capture the value of its customers' corresponding reductions in load

Figure 3. Impact of Price Responsive Demand on the Planning Process

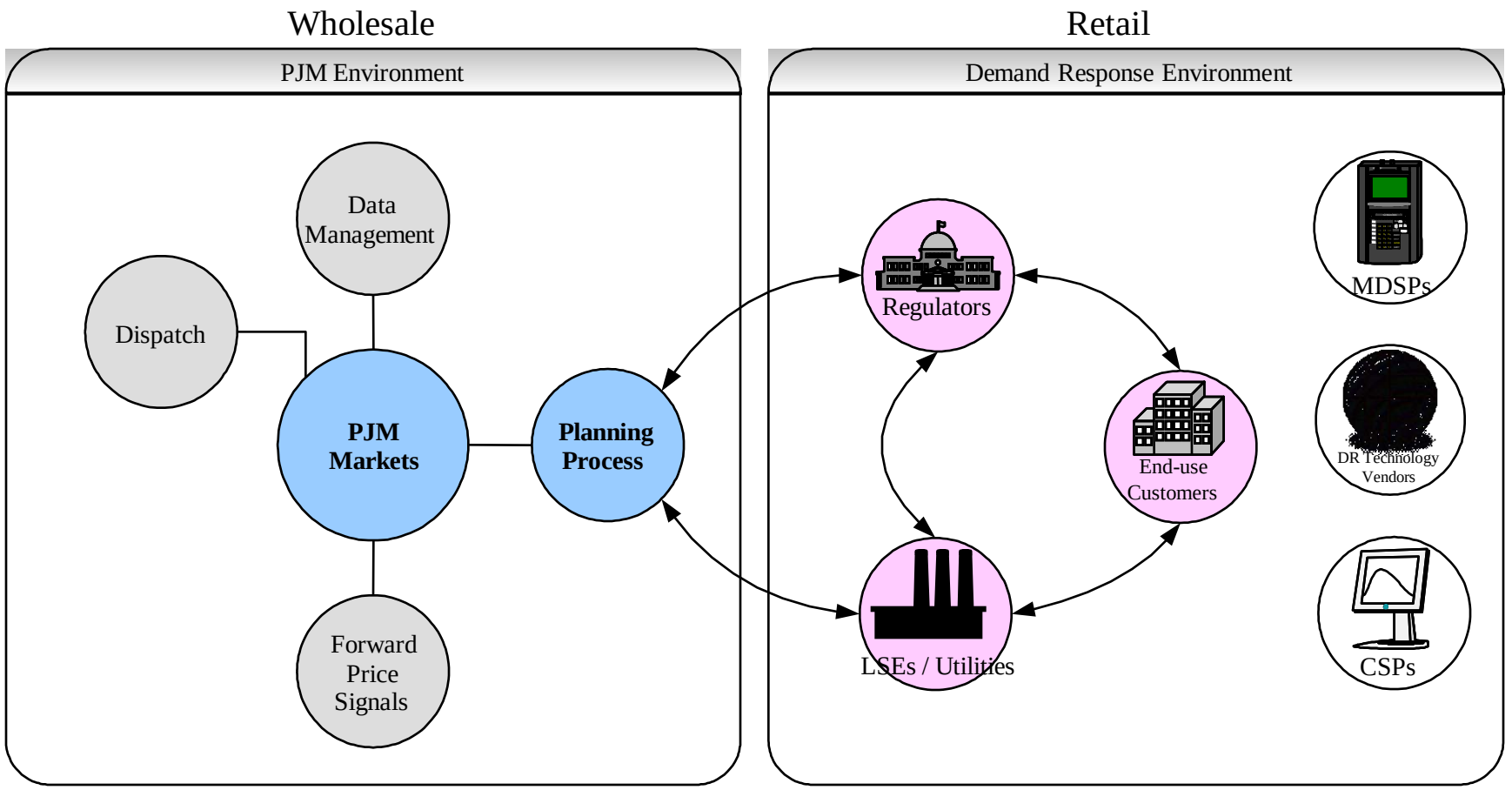


Table 3. Price Responsive Demand as a Variable in the Load Forecast

WHOLESALE	RETAIL
1. Process in consultation with the Planning Committee and the Load Analysis Subcommittee to: a) Calculate unrestricted peak b) Use PRD data provided by LSEs to quantify the impact of price responsive demand (PRD) c) Subtract MW of PRD from unrestricted peak d) Use energy efficiency data provided by LSEs to quantify the impact of retail energy efficiency (EE) goals e) Subtract MW of actual unanticipated EE from unrestricted peak f) Avoid double counting g) Account for location of price responsive demand (PRD) 2. Process expected to evolve over time as PRD quantity grows and experience is gained 3. Experience with PRD expected to lead to improved calculation of the value of lost load	1. Implement dynamic prices that affect zonal load at peak: a) Critical peak prices b) Critical peak rebate c) RT and DA LMP d) Block and Index 2. Quantify reduction in firm demand, which is the residual demand after taking account of price responsive demand (PRD), during peak load conditions 3. Quantify reduction in firm demand during peak load conditions that is attributable to actual unanticipated energy efficiency

Figure 4. Impact of Price Responsive Load on Forward Procurement of Capacity

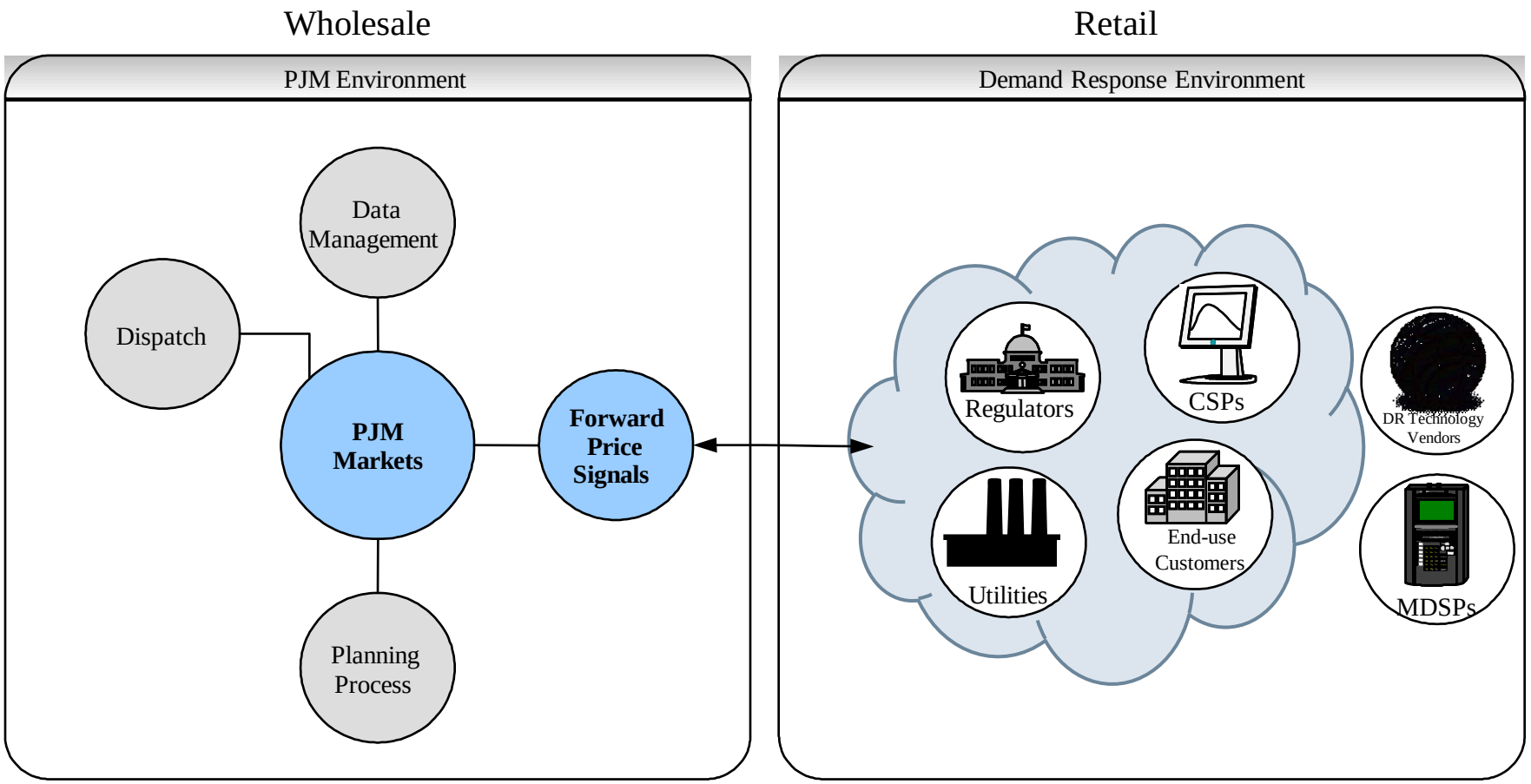


Table 4. Capacity Commitments of Load Serving Entities must be Enforceable

WHOLESALE	RETAIL
1. Transition through 2012/2013 planning year: a) PRD registered as interruptible load for reliability (ILR) through 2011/2012 planning year b) PRD offered as a Demand Resource (DR) in incremental auctions through 2012/2013 2. Ability to reflect PRD in forecast of firm demand in incremental auctions held after May 2010 for planning years 2010/2011, 2011/2012 and 2012/2013 3. Ability to reflect PRD in forecast of firm demand in procurement for 2013/2014 planning year available for the base residual auction in May 2010 4. Develop ability to implement involuntary curtailment in a non-discriminatory manner 5. Develop penalties/consequences for LSEs that exceed capacity entitlements during emergency events	1. Load Serving Entity must ensure that load does not exceed its capacity obligation during system peaks or emergency events by: a) Implementing dynamic pricing that predictably reduces load b) Using capability of advanced metering infrastructure (AMI) to target, implement and confirm curtailment c) Procuring "extra" capacity as a hedge against non-performance d) Developing "extra" generating capacity as a hedge for PRD and intermittent resources e) Procuring "extra" capacity as needed bilaterally through the Power Contracts Bulletin Board or Incremental Auctions