

# PLMA Fall 2004 Conference Technology Session

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# Achieving Electricity Market Value Through DR Technologies

- How market conditions or signals dictate the use of one-way or two-way communication approach for a deregulated market and all its players/values (i.e., generator, ISO, Utility Distribution Company, Energy Service Provider, Customer, Insurers)

# Today's Plan

1. Customer orientation approach
  - A starting point on
    - how to recoup sources of value, and
    - the need to develop stable market rules
2. Addressing market value/technology development connection
  - How sources of value can be directly (or indirectly) instilled into sizzling technologies for development of DRR

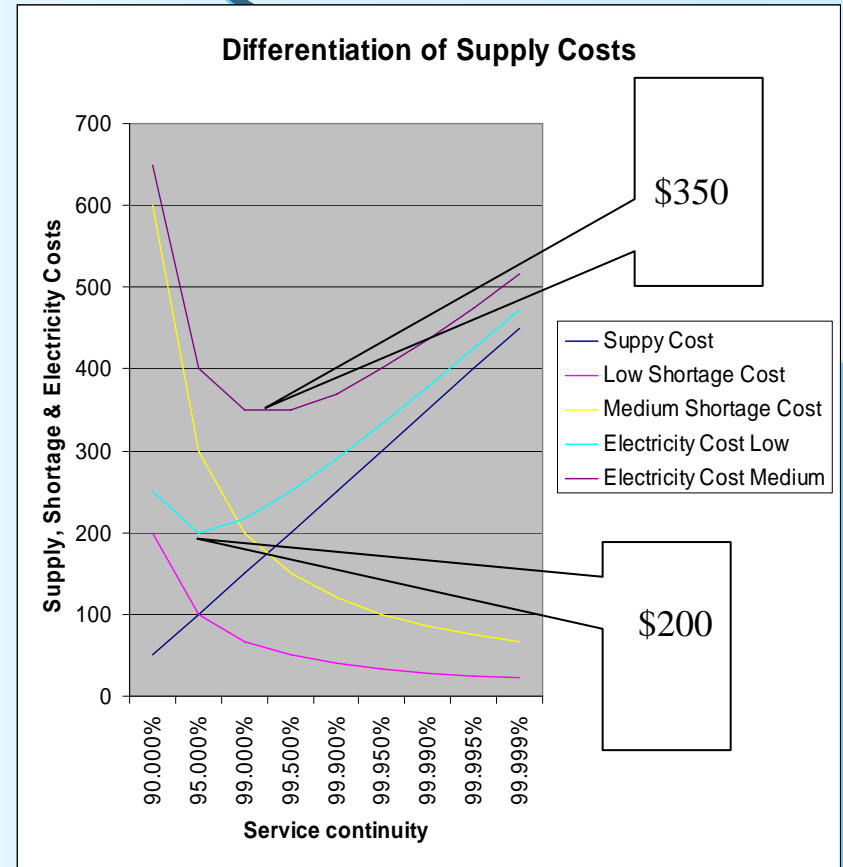
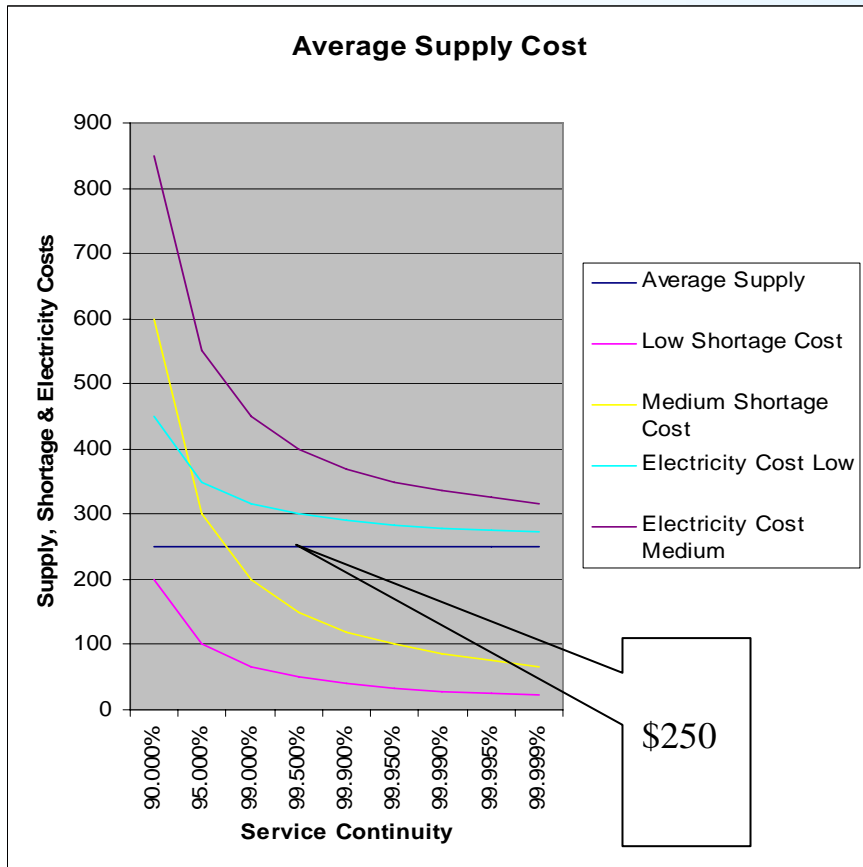
# Electricity Cost under a Customer Orientation

Customer's Electricity Cost = Supply Cost + Shortage costs

Supply Costs = Energy Cost + Supply Security Cost

- Differentiation of supply security cost eliminates either/or choice between firm and non-firm power
  - Customers with **low Shortage Costs** can elect service with **low Supply Security Cost** and vice versa
  - Customers of **high Shortage Costs** should “buy” **Supply Security to those with lower Shortage Costs**
  - The result of such differentiation is the **opportunity for every customer to choose the most cost-effective plan from a portfolio of contracts**, thereby increasing social and economic welfare, while financing capital investment with higher efficiency

# Comparison of Average and Differentiated Supply Costs



# Customer Orientation Around Three Principles

- DR on a price response system may give away profits to customers that don't respond and free ride the system.
- Before developing technology to recoup DR value, under a Customer Orientation, further work is suggested to be done around the principles of Demand Response Planning\*
  - Multiple Load Shape Objectives
  - Pricing and Incentives, and
  - A Condition of Electric Service

\* New Principles for Demand Response Planning, EPRI, Palo Alto CA: 2002. 1006015.

# System Operating States Instead of Shape Objectives

- **Normal (NOS) \***
  - Economic dispatch of generation (EDG) done within the economic deadband of bulk power system hourly safe probability of disturbance (i.e. LOLP that results in maximum welfare)\*\*
  - On excessive generation or transmission reserves, EDG with DR restoring action opportunities, when within NOS and outside of the economic deadband.
- **Alert (AOS)**
  - On insufficient reserves, system operator signals automatic price increase and thus DR opening action to return to NOS
- **Emergency (EOS)**
  - On severe disturbance, violating inequality constraints, system operator executes - direct control to shift to NOS or AOS ASAP to avoid shift to IOS
- **In Extremis (IOS)**
  - To be avoided as much as possible, by operating within NOS calculated risk
- **Restorative (ROS)**
  - Automatic price signals DR restoration from higher to lower outage opportunity costs, leading to NOS. Some direct control may apply to sensitive loads.

\*Superior to system shape objectives

\*\*Calculated risk may require DR open loads

# Trade off with DR just in case something happens

- Supply Orientation

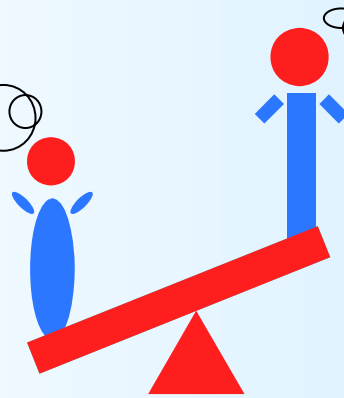
- By doing corrective action (DR) the system is more reliable, but by definition, is no longer dispatched in the most economical way.
- Often corrective action is not actually applied before the fact (in the short-run), since outages are not too frequent.

- Customer Orientation

- In the long-run, constantly meeting agreed system reliability target is the most economical way to dispatch generation and DR
- DR is performed to keep the system in the Normal Operating State economic deadband

# DR and Calculated Risks

With  
Demand  
Response  
we can...



... keep the  
system stable

# Value of Lost Load (VoLL): Pricing and Incentives, and A Condition of Electric Service

## ● Supply Orientation

- A single System VoLL representing all customers
- Expected spot price =  $\text{LOLP} * (\text{VoLL} - \text{SMP}) + \text{SMP}$
- I.e., Are LOLP results resulting from generators forced outage rates tied to liabilities after unit commitment in the market rules?

## ● Customer Orientation

- One CVoLL function for each customer
  - Retail marketing
- Ask and Respond: the Four Who's to develop a set of self-consistent and successful market rules
  - Who provides, Who benefits, Who pays and, Who loses
  - Include Generators, ISO, Utility Distribution Company, Energy Service Provider, Customers, Insurers

# Customer Orientation: Recoup Mechanism

- DR performs a reserve function from which all other agents benefit and a Recoup Mechanism of most of those benefits is needed to develop and finance a vibrant DRR System
  - On the examination of the Four Who's, property rights give clues for a fully developed and financed DRR System
    - Generator and transmission line failures under their responsibility should be liabilities to the agents
      - Need for proper risk management and improved maintenance
    - Divide profits of higher load factors on generation
    - Reduce free riders benefits and new ISO investments
  - Rotating reserves and DR profits should come from total service and not just from the transactions
    - A need exists to transform public goods into recouped profits

# Customer Orientation Around Three Principles (bis)

- An alternative to Load Shape Objectives principle that satisfies a customer orientation is proposed that can be based on calculated risk and system operating states to fit
  - “Well designed DR options allow customers to make informal choices to tailor their actions so as to balance energy costs with value of service”\*
- Work related to Value of Load Loss, or similar constructs, lead to opportunities to reduce free riding and transform to profits public value above apparent equal terms (i.e. system reliability), while
  - “Designing DR incentives into the customer price structure allows all customers and all loads to participate on equal terms”\*
- Capturing customer Value of Load Loss information for DR value creation as part of customer service contract, where
  - “Demand response options should be available to all customers as an integral component of customer service”\*

\* New Principles for Demand Response Planning, EPRI, Palo Alto CA: 2002. 1006015.

# Examples of Technology Planning for DR Purposes

- One-way or two-way communications for mass-market residential programs, apply the principle of Advanced Metering and Communication
  - Technology infrastructures (e.g., AMR infrastructure) conducive to price-based programs
  - Need to keep DR investment and transaction costs as low as possible, for lower segment of customers, consistent to with the principle of Condition of Electric Service, that requires all customers to select a service plan
    - Basically the plans will be on one-way and two-way communication systems
- Permission-based automatic control of equipment in large commercial/industrial facilities

# One-Way Communication with Predetermined Prices

- A low budget option available to all customers as an integral component of customer service, may be predetermined pricing, for transition period and developing countries
  - Suggest week-ahead predetermined prices to low budget residential and agriculture consumers, so they can program their weekly activities, and ISO develop its week ahead unit commitment (day ahead is also needed).
  - This option can be implemented with proactive interaction with ISO on any mass market media as the second communication channel.
  - Risk management may involve insurance industry
  - Very useful on deep and prolonged energy shortages
    - Low prices may involve a customer obligation to serve

# DR Design on “One-way” Communication low end segment

- Low budget responsive meters, suitable for week ahead pre-determined prices
  - With AMR picking up customer signals entered
    - Customers may program voluntary interruptions on specific hours
    - Customer activated demand limiters
    - AMR design based on overnight traffic hours
    - Customer failures (or mistakes) to update may result in higher electricity costs (larger bills or higher interruption costs) than required.
  - Without AMR
    - Pre-paid meters with hourly predetermined prices

# Two-Way Communication:

- The remainder of customers can be fitted with
  - Any available technology or any new technologies on the pipeline or the drawing board
    - Cell phone messaging, pagers, regular PLC, broadband PLC, traditional phone service, etc., even in hybrid modes, should be expected to operate efficiently, under all system operating states within a given control area
    - Cases of three-way communication may result
      - Beeper for EOS and ROS and two-way for NOS, AOS and ROS
  - Traditional supply oriented (load management), permission-based automatic control of equipment in large commercial/industrial facilities, which should
    - Continue permission/based DR service on EOS
    - Add customer oriented, voluntary programmable DR infrastructures price-based programs for DR acting on AOS and ROS
- ISO needs advanced warning of customer DR dispatch operations

# Conclusions & Next Steps

- Achieving market value through DR technologies requires further work to transform some public value sources of profits into recoupable profits for players
  - Through the development of a set of self-consistent and successful market rules
- To facilitate that all customers select the service plan that fits their needs
  - One-way communication budget mass/market DRR also needs to be develop and marketed
- Next Step: Develop Self-Consistent Market Rules
- Thanks... open to respond to some questions