Making the Distribution Grid More Open, Efficient and Resilient

Paul De Martini
Newport Consulting
Caltech Resnick Sustainability Institute

March 26, 2015
Grid Evolution: One-way Road to Grid of Things

Grid increasingly becoming a multi-directional network potentially interconnecting millions of intelligent consuming devices and flexible DER and back-up generation.

Operating such a system requires greater situational visibility and collaboration with customers and their services providers.
How Will We Develop & Operate an Integrated Grid?

Focus on Customer Value & New User Needs

- Integrated Grid Planning
  - DER Hosting Capacity
  - Locational Benefits
  - Integration w/Trans. & Resource Planning
- Grid as an Open Platform
  - Leverage Current Investments
  - Evolve to Create “Plug & Play” System
- Integrated Distribution Operations
  - Manage distributed power flows
  - Coordinate physical flows across T-D interface
- DER Market Opportunities
  - Expanding opportunities to provide services
  - Market structures vary and should align with parties’ respective needs

Changes to Traditional Distribution Lifecycle Management Processes Required
Distribution Planning Process

Integrated Grid Planning Required – California Dist. Resources Plan Example

Shift from Deterministic Engineering Analysis + System level Benefits Analysis Toward Dynamic Engineering Methods with Locational Benefits Incorporated
What Type of Distribution Grid Do We Want?

**Seamless:**
- Enable multi-directional real & reactive power flows
- Enable transactions across distribution with utility distribution company, bulk power operations and wholesale market

**Open & Transparent:**
- Low barriers to access physical connections & value monetization opportunities
- Streamlined interconnection rules and processes
- Transparent processes for planning and operations
- Access to distribution planning & operational information (qualified access)
- Transparent locational value determination and monetization

**Network & Convergent Value:**
- Physical and operational qualities that yield greater safety and reliability benefits
- Qualities that may create greater customer/societal value from each interconnected DER (“network effects”)
Integrated System Operations Evolution

Scale Adoption of DER will Require New Distribution Operational Functions & Integration with Bulk Power System Operations

Model A: TSO optimizes the whole integrated system – all the way down into the distribution system including managing coordination of all DER services schedules

DSO only responsible for safe and reliable distribution operations

Model B: TSO optimizes only the transmission system – sees multiple aggregate or “virtual” resources by Aggregators & DSO at each T-D interface.

DSO responsible for physical coordination of DER services to T-D Interface and safe & reliable operation of distribution grid

Model C: TSO optimizes only the transmission system – sees a single aggregate or “virtual” resource at each T-D Interface managed by DSO

DSO responsible for physical coordination of all DER services to T-D Interface and safe & reliable operation of distribution grid

Adapted from: L. Kristov CAISO

DSO Considerations Should Start with Functional Requirements Before Deciding Roles
Distributed Market Design

Distribution Market Design has 3 Integrated Elements

- Customer, Environmental & Grid Values
- Service Definitions & Requirements
- Market Structures Aligning Parties’ Req.’s

Alignment Required Across Elements

Competitive Procurements w/Bi-lateral Contracts Most Likely for Distribution Opportunities
Tariff Designs & EE Program Incentives Aligned to Locational Value & Dist. Constraints

Not clear from CA MTS discussions how DMP or Spot Markets facilitate alignment
California MTS Working Group
http://greentechleadership.org/mtsworkinggroup/