



How the Smart Grid Increases the Importance of the Distribution System

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From the System Operator's Perspective, Supply Is Becoming...

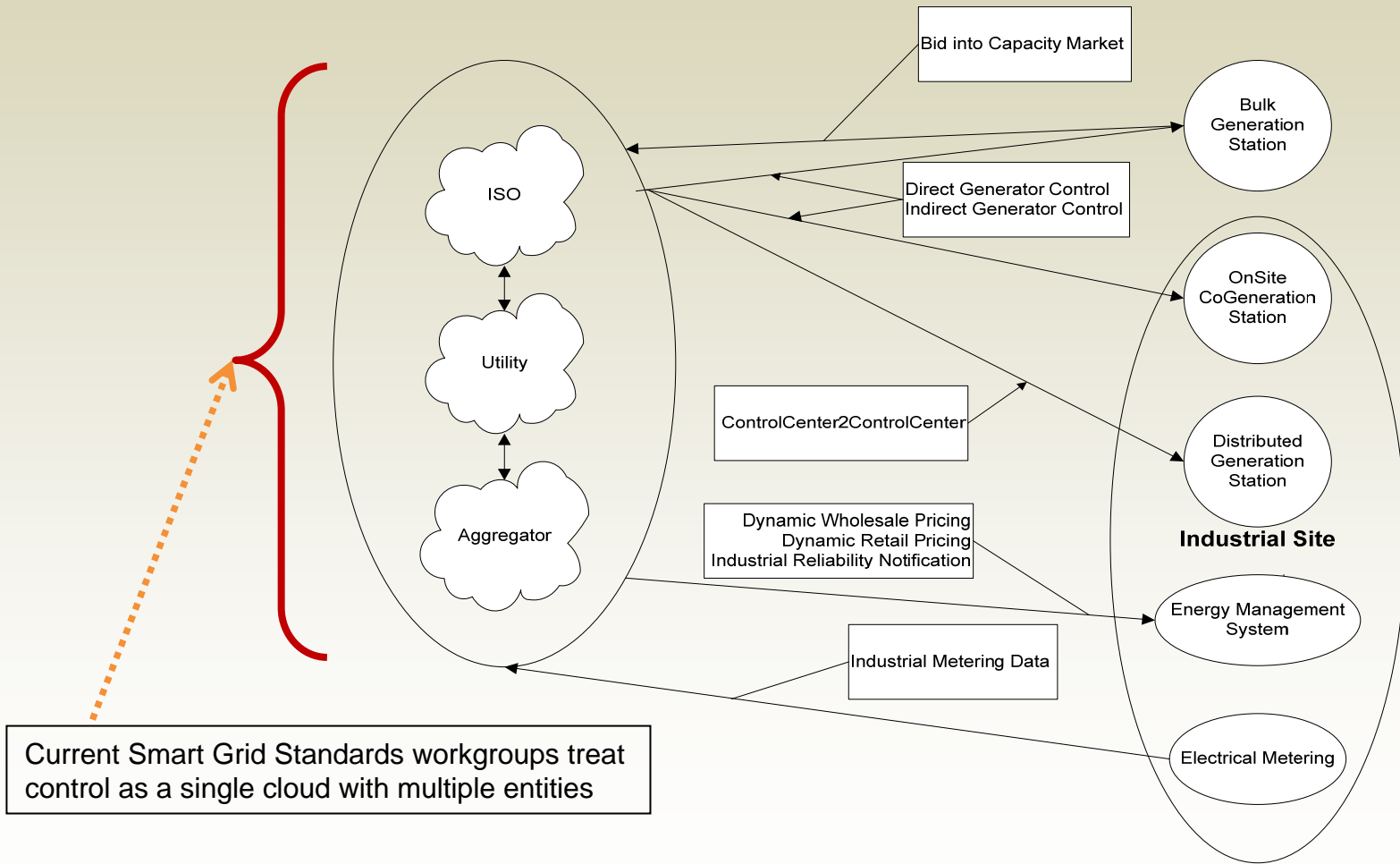
- Less Schedulable
 - Increasing penetration of variable resources
- Less Dispatchable
 - Ditto
- Less "Firm"
 - Ditto
- More Distributed
 - Renewables, DG, etc.

Less Visibility, Less Control

From the System Operator's Perspective, Loads Are Becoming...

- **Less Predictable**
 - Served by “Behind-the-Meter” variable generation
 - Embedded in Microgrids
- **More Dispatchable**
 - Demand response
 - Storage?
- **More Price-Sensitive**
 - Usage and price data more available
 - CPP tariffs
- **More Temperature-Sensitive**
 - Population moving to hotter areas
 - House sizes growing

Most Current Thinking on Standards Does Not Address the Problem



Source: NIST I2G Draft Roadmap V 0.5 dated 4/9/2009 & ISO-NE (modified)

What's Missing in Smart Grid Standards

- Much attention has been focused on end-use interfaces:
 - H2G, I2G, B2G, V2G ...
 - End-use customer visibility of prices and demand response
 - Advanced metering
- Some (but not enough) attention has been focused on transmission functions:
 - PMU monitoring; Situational Awareness
- Virtually NO attention has been focused on Power System Control and the information exchanges needed for control functions among System Control entities, e.g.:
 - ISO ↔ Utilities
 - ISO ↔ Aggregators
 - ISO ↔ Other Control Areas

Information Exchanges Are Needed to Integrate the Smart Distribution Grid

- Information exchanges between the system operator and operators of Distributed Energy Resources (DER) connected to the distribution grid
 - Distributed generation
 - Demand response
 - Storage
- Some of the gaps recognized in the May NIST Smart Grid Interoperability Framework Standards Workshop:
 - Use of distribution resources for contingency analysis, mitigation, and control (including restoration)
 - Impact of distribution activities on transmission capacity
 - Functional integration of EMS and DMS functions and market operations systems
 - Rules for information exchange between unbundled entities

Metrics for the Integration of the Smart Distribution Grid

- Proposed DOE metrics are a good start *but need to include the System Operator*
 - Percent of...DG and Storage that Can Be Controlled *by the System Operator*
 - Percent of Load...Served by Distributed Resources *known to the System Operator*
 - Percent of Systems Accommodating Off-Peak Renewable Energy [and] Dispatching On-Peak through Storage *known to the System Operator*
- Some possible metrics (not addressed by the proposed DOE Metrics) are:
 - The amount of DER participating in ISO markets (for energy or ancillary services)
 - The amount/percent of DER visible to the system operator