U.S. Department of Energy

WORKSHOP ON VALUATION OF BENEFITS AND COSTS OF DISTRIBUTED GENERATION

Inputs and Methods Affecting Estimates of Control/Grid Services Provided by Grid Operator to DET User

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Introduction and Overview

- **The previous sessions focused on the value of DETs could provide to the utility**
  - Benefits of DETs are couched in terms of avoided costs for utility operations and infrastructure
- **This session focuses on the value the grid *provides the DET owner* – an alternative way of looking at value**
- **Emerging new point of view; DET Owner**
  - **Grid-POV**: the cost for the grid to supply those same services
    - This corresponds to a more traditional utility point-of-view
    - Many (but not all) of these values were discussed in previous sessions
  - **DET-POV**: the cost for a consumer with DET to self-supply the load, providing all services offered by the grid as if operated as an island
    - This “upside down” perspective proved useful in offering insights about additional values

Services Considered

Typical Values Considered

Additional Values to Consider (brought to light by DET-POV)

Service	Description
1. Capacity & load shape	• Provide energy required to meet load in excess of DET supply • Absorb excess energy supplied by DET after load is met • (Lack of) load shape diversity
2. Imbalance energy (short-term volatility)	• Provide or absorb energy for short-term load variations around load shape • (Lack of) short-term load diversity
3. Ramping	• Provide energy not supplied by DET due to DET's limited ramp rate • Absorb excess energy supplied by DET due to DET's limited ramp rate
4. Frequency regulation	• Control system output so that (60 Hz) frequency is maintained
5. Transient stability	• Inertia + primary frequency droop control
6. Voltage regulation	• Control voltage within ANSI standards
7. Supply VARs	• Supply reactive power needed for reactive loads
8. Reserve capacity	• Spinning + operational reserve capacity for forced and planned DET outages
9. Maintenance	• Responsibility and risk for maintenance of generation
10. Dispatch planning	• Responsibility and risk for scheduling & control of generation
11. Capacity planning	• Forecasting & capacity expansion planning
12. Fuel supply	• (Lack of) reduced fuel costs from bulk (wholesale) purchases, long-term contracts
13. Economies of scale	• (Lack of) ability to utilize generation only available in large sizes (e.g. nuclear) • (Lack of) ability to access lower cost capital available to utilities
14. Supply diversity	• (Lack of) hedging and competition provided by diversity in generation resources
15. Access to remote renewables	• (Lack of) ability to use remote carbon-free resources (e.g., hydro, wind)

Commonly Considered Values Provided to DET by Grid

Service	Valuation	Methods & Issues
1. Capacity & load shape	• Cost of G, T, & D capacity to manage peak load • Cost of supplying imbalance energy needs with bulk generation (wholesale market or production cost)	• Industry practice well established for capacity • Load composition complexity increasing; new efforts to capture behaviors of emerging power electronics etc. becoming of interest
2. Imbalance energy (short-term volatility)	• Energy cost of supplying regulation	• Production cost modeling well established • Recent work indicates data access challenges Including handling multiple owner issues etc. • Emerging use of uncertainty in imbalance forecasting
3. Ramping	• Marginal cost of dispatched generation when mix changes due to ramp rate limitations	• Ramping issues increase with increased DET penetration • Wind ramp forecasting topic of much effort
4. Frequency regulation	• (Market) cost for regulation services, discounted by fraction used for area imbalance • Additional power plant costs for primary frequency (droop) control • Fuel & wear-and-tear costs for primary frequency control	• Current practices well established • Interconnections experiencing frequency response challenges

Commonly Considered Values Provided to DET by Grid from Two Points of View (cont.)

Service	Valuation	Methods & Issues
1. Transient stability	• Cost for transmission SCADA, EMS, PMUs, etc. used to provide transient stability • Costs for power flow control, dynamic path ratings etc.	• Detailed engineering studies to determine cost of reliability under high DET scenarios • Emerging high resolution data resources emerging to enhance transient management; access a challenge
6. Voltage regulation	• Generation costs for supply required VARs, including losses • Additional power plant & transmission EMS costs for controls needed to maintain voltage stability • Fuel & power plant wear-and-tear costs for maintaining voltage stability • Distribution voltage control systems & equip. (tap changers, voltage regulators, cap banks)	• DET voltage impacts of high interest • Performance of emerging smart inverter concepts need to be reflected in engineering study tools
7. Reserve capacity	• Spinning reserve (market) capacity & dispatch costs • Non-spinning (replacement) capacity & dispatch costs • Operational reserve capacity costs • Fixed O&M costs for all reserve capacity	• Discussed earlier

Summary of Key Points

1. **Bulk system services embedded in power costs (DET perspective) ... Emerging DET owners increasing their sophistication and interest in valuing grid services**
2. **Many bulk system valuation studies cross state boundaries, adding complexities; new efforts promising**
3. **DET futures make load more complex and active player in grid operations; load composition tools needed?**
4. **EMS / DMS tools moving to better reflect uncertainty; will improve operator ability to mitigate historic cost risks**
5. **Data access a barrier in current EIM efforts**
6. **Future reliability management for fast events (frequency response, transients) increasingly dependent on new monitoring concepts**
    1. New (multiple) opportunities for improved leverage of DET ... How to value?
    2. Challenges in data access, data management & cost allocation