Realizing the Benefits of DER, DG and DR in the Context of SmartGrid

SmartGrid Operations: Making VPPs Actionable

Carlos A. Romero
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Objective

- Overview of SmartGrid
- Definition of Virtual Power Plants
- SmartGrid Operations Workflow
- Benefits Case Study
Wholesale Demand and Supply Curve Without DR
Wholesale Demand and Supply Curve With DR

P [$/MWh]

Q [MWh]
Wholesale Demand and Supply Curve With DR

- IN-flexible Demand
- Commercial
- Industrial
- Demand Response
- Distributed Generation
Benefits of Implementing DR in the Demand and Supply Curve
Demand Response Defined

• Demand Response (DR): A temporary reduction (or shift) in end use customer demand made in response to adverse economic or reliability conditions
  – DR excludes Energy Efficiency, which is a sustained, rather than temporary, reduction
• DR Resource: A measurable & verifiable reduction in end use customer demand
  – Remote control switches on A/C, water heaters, pumps
  – Programmable thermostats and appliances
  – Building energy mgmt. systems
  – Backup generators, batteries, storage
• DR Program: The rules governing the operation of DR Resources
  – Eligibility & registration
  – Rate incentives & penalties
  – Measurement & verification
  – Curtailment limits & event notification
Virtual Power Plants – SmartGrid Programs

DIRECT LOAD CONTROL
- PROGRAMMABLE THERMOSTATS
- HVAC CONTROL
- WATER HEATERS
- POOL PUMPS
- HOME ENERGY MANAGEMENT SYSTEMS

PRICING PROGRAMS
- PEAK TIME REBATES
- TIME OF USE
- REAL TIME
- CRITICAL PEAK PRICING

DISTRIBUTED GENERATION & STORAGE
- DIESEL GENERATION
- WIND & SOLAR
- ELECTRIC CARS
- HOME BATTERIES
Benefits of Implementing DR in the Demand and Supply Curve

• Economic
  – Connect end customers to wholesale markets
  – More efficient energy costs
  – Better use of existing infrastructure
  – Deferment of new infrastructure (fuels, transmission, distribution, transformation, generation)

• Environmental
  – Reduction on emissions
  – More efficient use of fuel
  – Reduced impact on new construction

• Other
  – Customer satisfaction
  – New product and services
  – Other...
Virtual Power Plants
AGGREGATIONS OF DEMAND RESPONSE & DISTRIBUTED GENERATION

VPP North
Critical Peak Pricing

VPP West
DG

VPP South
RT Pricing Program

VPP Central
Storage

VPP East
Storage
### Virtual Power Plants Characteristics

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<th>Traditional Generation Asset</th>
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Traditional Demand Response

- One Way Communication
- Direct Load Control
- Limited Customer Interaction
Smart Grid Enabled Demand Response

- Two Way Communications
- Home Energy Management Portals
- Customer Interactions and Control
- Real Time Measurement
Virtual Power Plants

- Optimization of DER Execution
- Communication of Real Time Information
- Measure and React
- Economic and Environmental Impact Analysis
- Connects Commercial Operations to the Customer
Process Workflow for SmartGrid Operations

- Capacity Forecast
- DR Program
- Capacity Forecast
- Distribution Grid
- VPP Commitment
- Event Communications
- Results Analysis
Case Study 1
Case Study 1
Case Study 1
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Case Study 2
Case Study 2
Key SmartGrid Infrastructure

BUSINESS APPLICATIONS INFRASTRUCTURE
Portfolio Planning and Optimization, Price Forecasting, Distributed Generation, Generation Dispatch, SCADA/EMS, Contract Management, Load Forecasting, Outage Management, Wholesale Bidding and Settlements, Demand Response Programs, Virtual Power Plants, Customer Billing and Invoicing

DATA MANAGEMENT INFRASTRUCTURE
Servers, Data Storage, Modeling, Web Structure, Data Mining

COMMUNICATIONS INFRASTRUCTURE
Wireless, Broadband, BPL, Fiber, RF Mesh, Home Area Network

ELECTRIC INFRASTRUCTURE
Power Plants, Wires, Substations, Transformers, Relays, Meters, Customers
Natural SmartGrid Initiatives Steps

AMI PROJECTS

- Automate Meter Interactions
  - Customer Energy Portal
    - Benefits?
  - CUSTOMER CHOICE & DR
    - Costs??
    - ROI??

- VIRTUAL POWER PLANTS
  - DISTRIBUTED GENERATION
  - RENEWABLE ENERGY

Benefits?

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DAILY OPERATIONS & PLANNING DATA

WEATHER DATA
WHOLESALE TRADING
SYSTEM LOAD FORECAST
UNIT AVAILABILITY
FUEL PRICES & AVAILABILITY
SCADA/EMS

COMMERCIAL OPERATIONS

VPP MANAGEMENT
VPP OPTIMIZATION

FINANCIAL SYSTEMS & ACTUALS

BILLING SYSTEM
FINANCIAL SYSTEM
MDMS
REPORTING

CONTROL SYSTEMS

EMS
DMS
GRID TOPOLOGY

CUSTOMER MGMT

CIS / CRM
IVR

DISPLAYING

VISUALIZATION TOOLS
CUSTOMER / UTILITY PORTAL

EXECUTION

DEVICE CONTROLS
HAN

BILLING
DER Revenue
DER Results
Meter Data

Decision Making

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Summary: SmartGrid Operations

- Natural extension of existing Direct Load Control programs
- DER augments de value of traditional resources
  - Energy and Reliability
- Considers T&D issues of linking Retail and Wholesale operations
- Integrates cleanly into existing Commercial Operations Unit Commitment and Scheduling processes
  - Joint optimization with existing generation portfolio
- Applicable to existing or future environmental or RPS initiatives
Ventyx SmartGrid Benefits

- Make the data actionable to achieve significant benefits at the operational level
- Achieve an integrated view and capability across DR, DER, renewable resources, emission constraints and investments
- Connect commercial operations to the customer
- Reduce the need for investment on new capacity by leveraging SmartGrid investments
Smart Grid Operations Summary

• Smart Grid should have
  – Integration (operations/IT)
  – Optimization/Forecasting
  – Correct and adapt in real time
• Smart Grid can help utilities improve existing operations
• Smart Grid needs to be part of the vision of the utility (next 20 years), but also needs to have specific short term milestones
• Demand Response programs require coordination between utility operations and the customers (expectations)
• The value of Virtual Power Plants in Commercial Operations
  – Traditional emergency/reliability
  – Economics: Operating cost and Investment
  – Energy, A/S, Fuel, Ramping
  – Integration with Renewables