Microgrid Business Models

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Context

Power Grid is Undergoing Transformation …

Grid of the Past

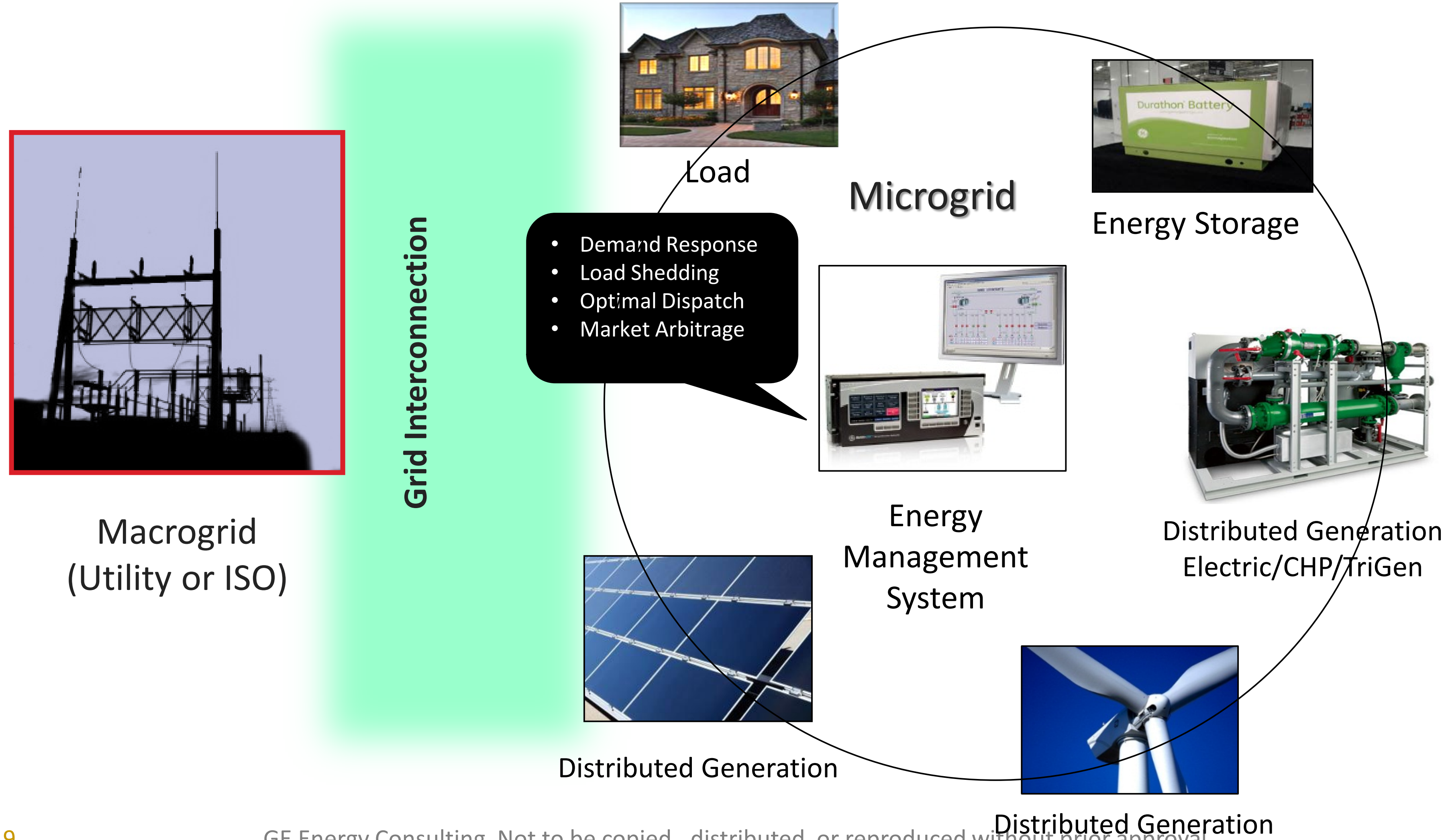
- Regulated Markets
- Central Stations
- Environmental Emissions
- Fossil Fuel Based
- Analog
- Passive Demand
- Consumers
- Flat Prices

Grid of the Future

- Market Competition
- Distributed Generation
- Clean Energy
- Renewables
- Digital
- Active Demand
- Prosumers
- Dynamic Prices

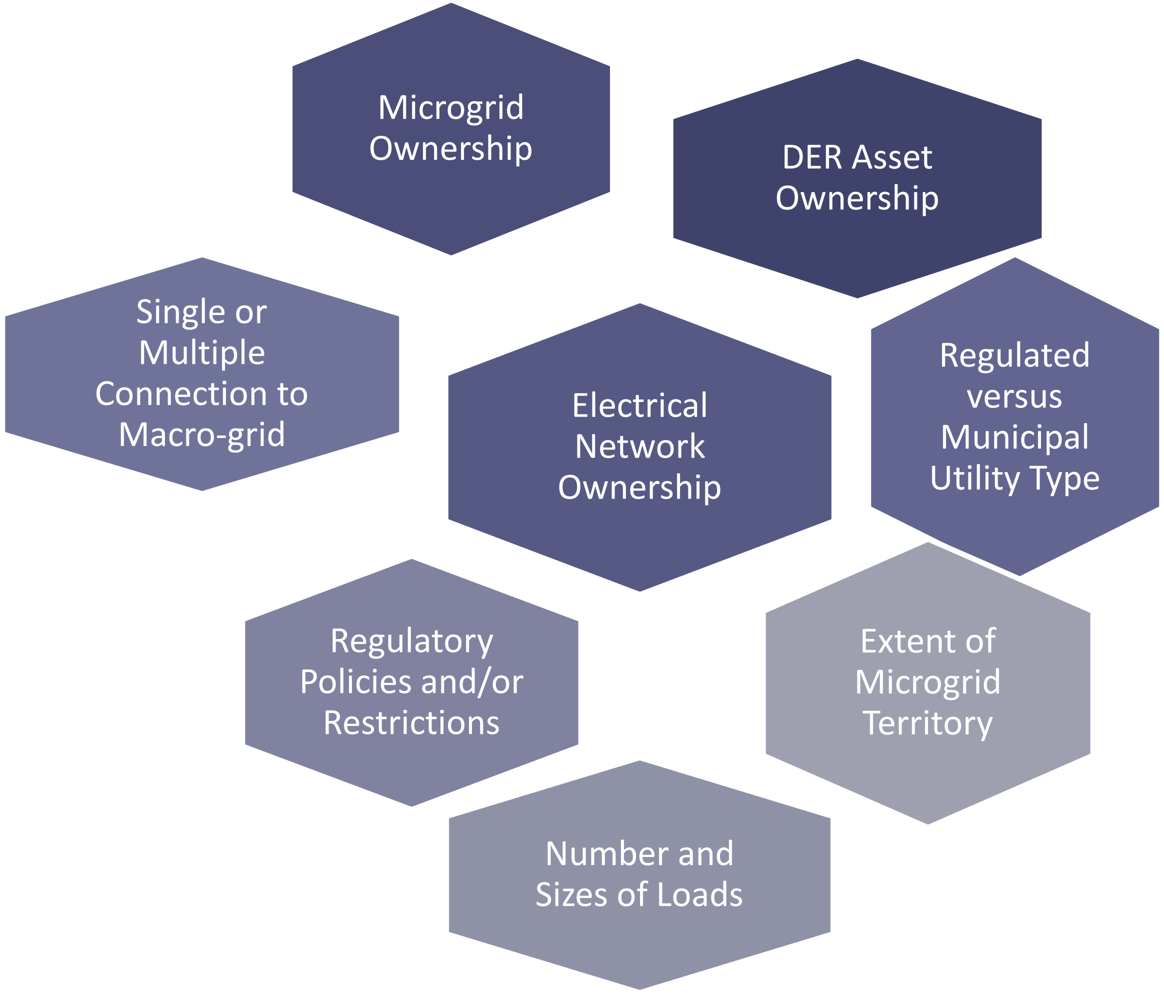
Source: Adapted from
GE PSEC Power System Course

Microgrids are a Novel Feature of the Evolving Power Grid

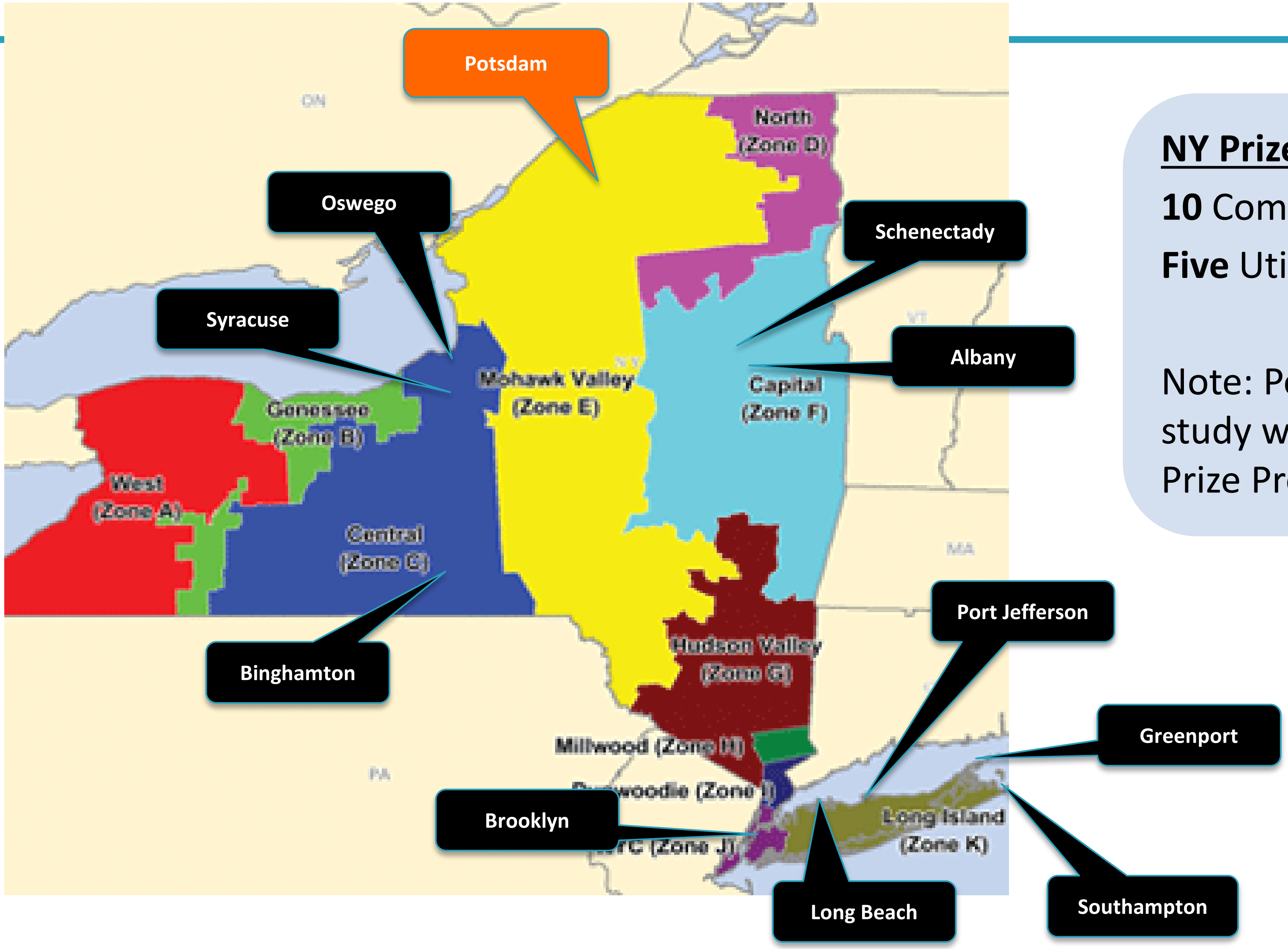


Microgrid Business Models Depend on Many Factors

Business model examples described in this presentation are taken from some of the microgrid studies performed in the State of NY, each characterized by a different mix of attributes shown here



NY Prize Stage 1 Projects



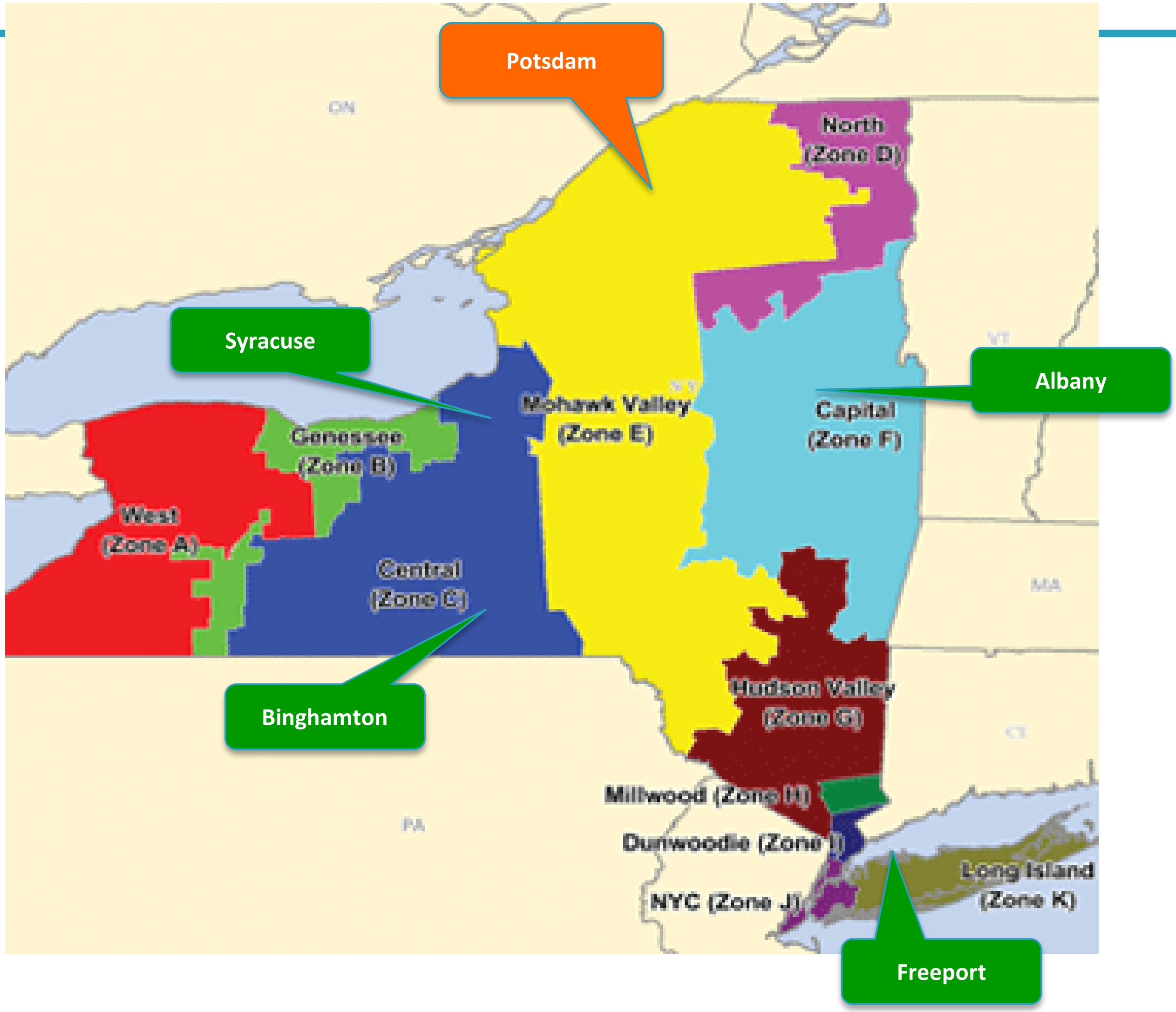
NY Prize Stage 1

10 Communities

Five Utilities

Note: Potsdam Stage 1 study was not a NY Prize Project

NY Prize Stage 2 Projects



<u>NY Prize Stage 2</u>

4 Communities

Three Utilities

Note: Potsdam Stage 2 study was not a NY Prize Project

Stages of Microgrid Development

Stage 1	• Technical and Economic Feasibility Study
Stage 2	• Engineering Design, Financial Analysis, and Business Model Development
Stage 3	• Engineering, Procurement, Construction
Stage 4	• Operations and Maintenance

Experience from Working on 13 Unique Microgrid Studies (some done in two stages)

Key Takeaway

There is no single business model applicable to all microgrids

Microgrid Essentials

To move forward, things that are needed:

- Technical feasibility
- Economic Viability
- Facility/Loads/Stakeholder Buy-In and Agreements
- Utility Cooperation
- Assured System Reliability
- Regulatory Approval
- Environmental Permits
- Financing Options
- Financial Returns
- Societal Benefit Cost Ratio > 1
- Taking advantage of Federal/State Incentives

Business Models Examples

Business Model Examples from our Microgrid Studies

- A: Mixed Utility and Special Purpose Entity Ownership
- B: Municipal Utility Ownership
- C: Total Private Ownership
- D: Utility Business As Usual with a Twist

Type A: Mixed Ownership

- Example of a Resilient Microgrid in Upstate New York
  - Utility builds, owns, and operates an underground microgrid network within its distribution system
  - Special Purpose Entity (SPE) owns and operates the Electric and Thermal DER assets within the microgrid
  - Microgrid to interconnect more a number of private and public Facilities/Loads, including:
    - Utility service facility
    - Private University Campus
    - Community Hospital
    - Village/Town Buildings
    - Police and Fire Stations
    - Supermarket
    - Gas Station

Type A: Mixed Ownership

Main Characteristics:

- Utility provides network, billing, and settlement services to the SPE and loads
- Utility recovers Capital and O&M costs through single or multi-tier “Resiliency Surcharges” applied to its “Delivery Charges”
- Utility contracts with SPE to provide Energy Management System (EMS) services
- SPE owns and operates the DER assets (or hires a third-party operator)
- During blue sky days, DERs/Loads can be net-metered and/or participate in the ISO markets
- During outages, microgrid is islanded and DERs power the microgrid
- Loads pay “Delivery Charges” to the utility
- Loads pay “Commodity Charges” to the SPE

Example B: Municipal Utility Ownership

- Example of a Resilient Microgrid within a Municipal Utility in New York
  - Microgrid covers all of the Muni's territory
  - Muni owns and operates microgrid's electrical network
  - Muni builds, owns, and operates microgrid's DER assets
  - All of the village network is considered a microgrid
  - Loads are all the residential and C&I customers of the Muni
  - During normal blue sky days, Muni can operate in the grid-connected mode (i.e., interconnected with the ISO grid)
  - During emergency/outage periods, Muni can island the whole village and provide continuous power to its customers

Example B: Municipal Utility Ownership

Main Characteristics:

- Muni provides network, billing, and settlement services to the SPE and loads
- All of the utility customers are under utility’s rate structure
- Muni may add a “Resiliency Surcharge” to the customers’ bills
- Or Muni recoups the incremental microgrid capital costs and O&M through sale of surplus power
- Muni DERs can participate in the NYISO’s energy, capacity, and ancillary services markets

Example C: Total Private Ownership

- Example of an entirely private Resilient Microgrid within an major urban area in Central New York
  - All of the microgrid electrical and thermal network and DER assets are in private lands
  - Microgrid has only one interconnection point to the utility's distribution system
  - A Special Purpose Entity (SPE) builds, owns, and operates microgrid's electrical and thermal network
  - SPE owns and operates microgrid's electrical and thermal DER assets
  - Microgrid operates behind the utility meter, and can be net-metered to the utility
  - Or it operates as a Virtual Plant with supply-side and demand-side resources providing energy, capacity, and ancillary services to the ISO

Example C: Total Private Ownership

Main Characteristics:

- SPE has contracts with all the microgrid loads
- SPE can provide both electrical and thermal energy to its customers
- SPE recovers its Capital and O&M costs through Delivery and Commodity charges to the microgrid customers
- SPE may have additional revenues by selling surplus power to the utility
- Or participate in the ISO wholesale markets of energy, capacity, and ancillary services
- SPE can take full advantage of all available federal and state incentives in selecting qualifying DER assets for its microgrid

Example D: Utility Business As Usual with no SPE

- Example of a Microgrid which only involves a Utility and a Major Power Provider ("Generator") in Central New York
  - The microgrid electrical network (a couple of miles in range) is entirely within and part of the utility distribution system
  - The Generator(tens of MW in capacity) is located within the microgrid territory
  - Utility defines the microgrid territory based on the technical feasibility of creating islanded network
  - Microgrid covers as many customers as possible, but within limits of the available capacity of the Generator
  - There is no need for any SPE, since Utility and Generator can have a bilateral contract and deal among themselves in order to provide continuous power to the microgrid customers

Example D: Utility Business As Usual

- Main Characteristics
  - During normal blue sky days, Utility provides services to its customers in a business-as-usual basis.
  - During Normal blue sky days, Generator is under contract with Utility selling power to Utility – acting as merchant generator participating in the ISO wholesale markets of energy, capacity, and ancillary services.
  - During Emergency/Outage periods, Utility can island the Microgrid
  - During Emergency/Outage periods, Utility has a contract with the Generator to purchase power for sale to the microgrid customers
  - Microgrid customers are under utility's regular rate structure with a Resiliency Surcharge
  - Utility recovers the incremental microgrid Capital and O&M costs through the additional "resiliency surcharges" over its the regular rates

Additional Features

DER Company (DERCO) acting as and ESCO

- Can contract to sell power and thermal energy to direct and indirect customers:
  - In normal/blue sky days, it will operate like other ESCOs in grid connected mode but with added advantage of having its own generation assets.
  - In emergencies and the outages of main grid outages, it will operate islanded mode and provide uninterrupted power to critical facilities.
- It can contract to sell power and thermal energy to <u>other</u> grid customers in grid connected mode (normal days).
- Generates Its Own Power and/or Purchases Power from ISO/Wholesale Market

DER-CO Value Proposition

- DERCO can have contract with customers outside the DER/MG like any ESCO.
  - DER-CO will see the LMP+D prices, but DERCO rates to customers buying from DER-CO can be based “fixed prices”.
  - Fixed prices can be below competition prices of “ESCOs without generation”, since during normal/blue sky/grid connected operation, DERCO can hedge against high market/LMP/hourly prices of ISO by switching to its own generation when purchased power prices are higher than its marginal cost of self-generation.
  - During Normal/Blue Sky days, the whole DER/MG may operate as a “virtual plant”, or its individual assets may operate independently from each other.
  - If regulators do not allow DER asset ownership by utility, then the non-T&D assets (i.e., distributed generation) could be owned by non-utility entities such as DERCO formed by DER asset owners.

Value Proposition

DERCO Owns and Operates DER Assets

- To meet its obligations to customers as supplier of electrical and thermal energy:
  - DERCO generates its own power and also purchases ISO/wholesale market power in order to meet its "supplier" obligations when in grid-connected mode (normal/blue sky periods).
  - DERCO generates its own power when in islanded mode (emergency/grid outage periods).
- In addition:
  - DERCO offers Capacity and Ancillary Services to the market.
  - DERCO acts as Virtual Plant and/or DR Aggregator of its customers' DR resources and offers DR to the utility/DSP and/or ISO.

Economic Viability

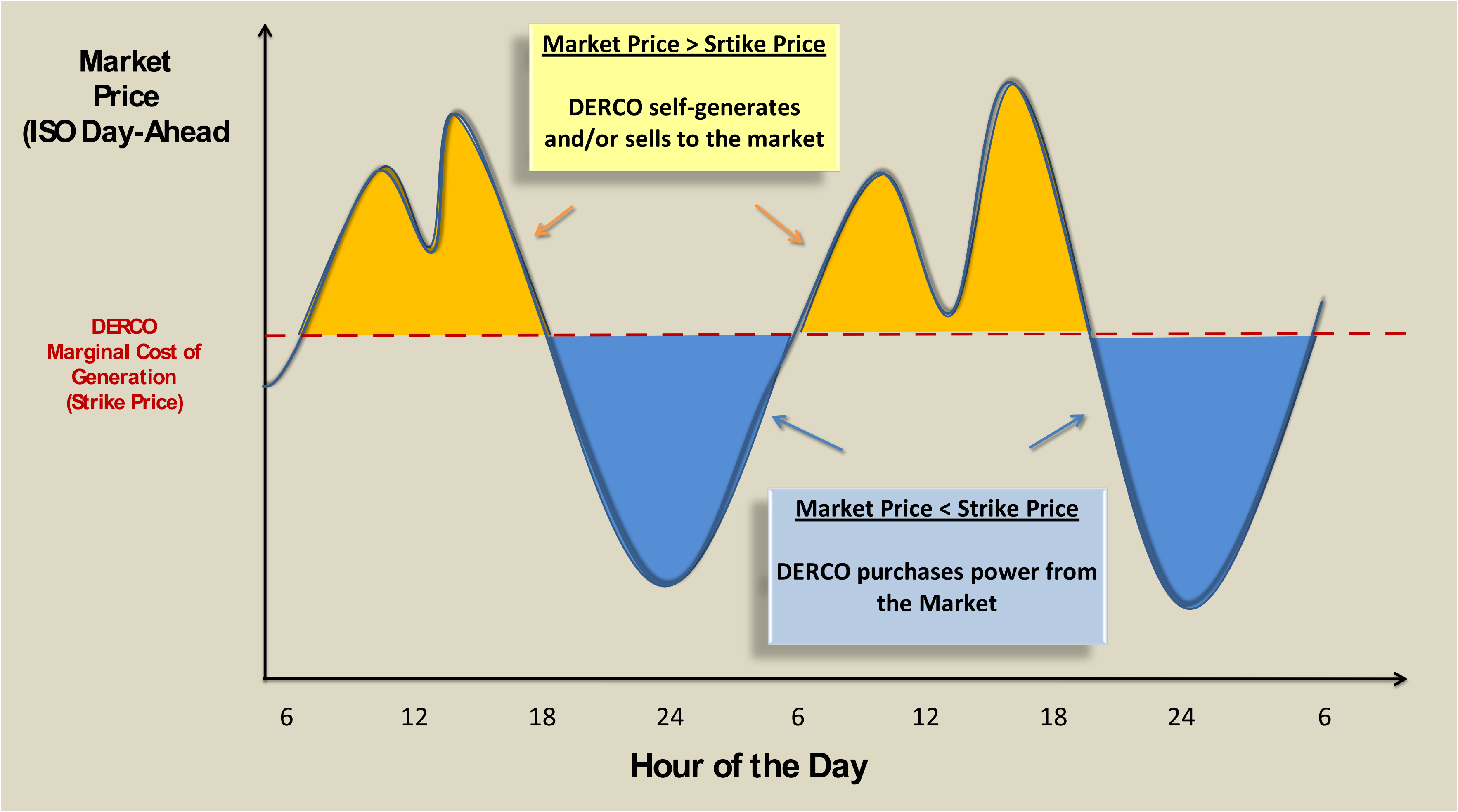
While meeting its supplier obligations, DERCO can use its DER assets to <u>hedge against higher market prices</u>:

- If ISO / wholesale market prices rise above marginal cost of generation of its DER assets, DER-CO will generate its own power.
- If ISO / wholesale market prices fall below marginal cost of generation of its DER assets, DER-CO will purchase power from the ISO / wholesale market.

- In contrast to the DERCO, an ESCO without its own generation would, on the average, pay the higher market prices (even if averaged under bilateral contracts).

Hence, DERCO's cost of generation is capped at the marginal cost of generation of its own DER assets.

DERCO Participation in the Energy Market



Note

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In this document, we sometimes use information derived from consolidated financial data but not presented in our financial statements prepared in accordance with U.S. generally accepted accounting principles (GAAP). Certain of these data are considered "non-GAAP financial measures" under the U.S. Securities and Exchange Commission rules. These non-GAAP financial measures supplement our GAAP disclosures and should not be considered an alternative to the GAAP measure. The reasons we use these non-GAAP financial measures and the reconciliations to their most directly comparable GAAP financial measures are posted to the investor relations section of our website at www.ge.com. [We use non-GAAP financial measures including the following:

- Operating earnings and EPS, which is earnings from continuing operations excluding non-service-related pension costs of our principal pension plans.
- GE Industrial operating & Verticals earnings and EPS, which is operating earnings of our industrial businesses and the GE Capital businesses that we expect to retain.
- GE Industrial & Verticals revenues, which is revenue of our industrial businesses and the GE Capital businesses that we expect to retain.
- Industrial segment organic revenue, which is the sum of revenue from all of our industrial segments less the effects of acquisitions/dispositions and currency exchange.
- Industrial segment organic operating profit, which is the sum of segment profit from all of our industrial segments less the effects of acquisitions/dispositions and currency exchange.
- Industrial cash flows from operating activities (Industrial CFOA), which is GE's cash flow from operating activities excluding dividends received from GE Capital.
- Capital ending net investment (ENI), excluding liquidity, which is a measure we use to measure the size of our Capital segment.
- GE Capital Tier 1 Common ratio estimate is a ratio of equity

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