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Working with Utilities in a Complex Regulatory Environment

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The Grid

- The most **complex machine** ever devised
  - The source of tremendous **economic development**
  - Runs on coal – a **threat to the planet**
  - Operational risk – **cascading failure**
- An electric power system with **common automatic controls** that:
  - **Balances** power from generation and imports with load
  - Maintains scheduled **interchange** with other control areas
  - Maintains the **frequency** of the electric power system
  - Maintains **operating reserves**
- **Control areas** now are:
  - **Integrated utilities**
  - **Regional Transmission Organizations (RTOs)**

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The Grid of the Future

- A **self-healing grid** provides **resiliency**
  - The grid can separate into self-supporting **islands**
  - Each island is its own **semiautonomous** control area supplied by DER
  - The islands can support one another through distributed energy resource management systems **(DERMS)**
- Microgrids provide **grid support services** when not in island mode
- Smaller, local, diverse resources reduce grid risk
- Utilities **invest in the platform**

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The Microgrid

A microgrid is a local electric system (**a local control area**) or combined electric and thermal system:

- that includes retail load and the ability to provide energy and energy management services needed to meet a significant proportion of the included load on a non-emergency basis
- that is capable of operating either in parallel or in isolation from the electrical grid
- that, when operating in parallel, is capable of providing energy, capacity or related services to the grid

Microgrid Resources Coalition

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Microgrid Performance

- Cogeneration efficiency beats the grid 80 to 35%
- Microgrids integrate Variable Energy Resources with hybrid generation
- Smart, integrated management of thermal loads
    - Uses thermal storage including building mass
- Customers arbitrage fuels and time of day

Microgrids invest to meet own needs, can provide multiple services to the grid at favorable prices

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The Utility

- Retail distribution
  - Plans and manages the Distribution System
  - Bills for energy and wires
- In an RTO
  - Maintains its transmission for RTO
  - Revenue requirement is wrapped by RTO tariff
- Outside an RTO
  - Typically vertically integrated
  - Acts as control area operator
  - Provides open access to transmission

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Utility DER Concerns

- Risks to grid operation
  - Too many variable energy resources (VERs) requires additional ramping resources and reserves
  - DER are invisible and unresponsive
- Risks to utility business models
  - DERs aren't paying costs of system – need large standby charges
  - Net metering is an unfair subsidy
  - DERs are destroying load and revenues (even if the utility doesn't own generation)

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Utility Constraints

- Must serve all customers fairly
  - Assets in rate base must be used to optimize grid for all customers.
- Can't generally own assets behind the meter
  - Can't optimize customer energy use
- State policies on generation ownership should be respected
- Utility - Private Partnership
  - Take advantage of strengths of each party

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Microgrid Constraints

- Is a Microgrid a utility?
  - Can it sell at retail?
  - Can it own wires?
- Self Generation is usually permitted
  - Most states allow a third party supplier on site
- Some states exempt multiple local customers
  - New York Qualified Facility exemption
- Other regulatory options
  - Retail electric supplier, Community Choice Aggregation
  - Utility/Private Partnership

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Princeton Microgrid

- Includes:
  - 15 MW cogeneration
  - 4.5 MW solar
  - 400 MWh Thermal Energy Storage
  - Advanced building controls
  - Advanced grid interface
- Survived Hurricane Sandy as an island
- Sells demand response and frequency regulation
- Arbitrages thermal storage and fuel diversity
- Supports critical research power quality needs
- Few regulatory hurdles

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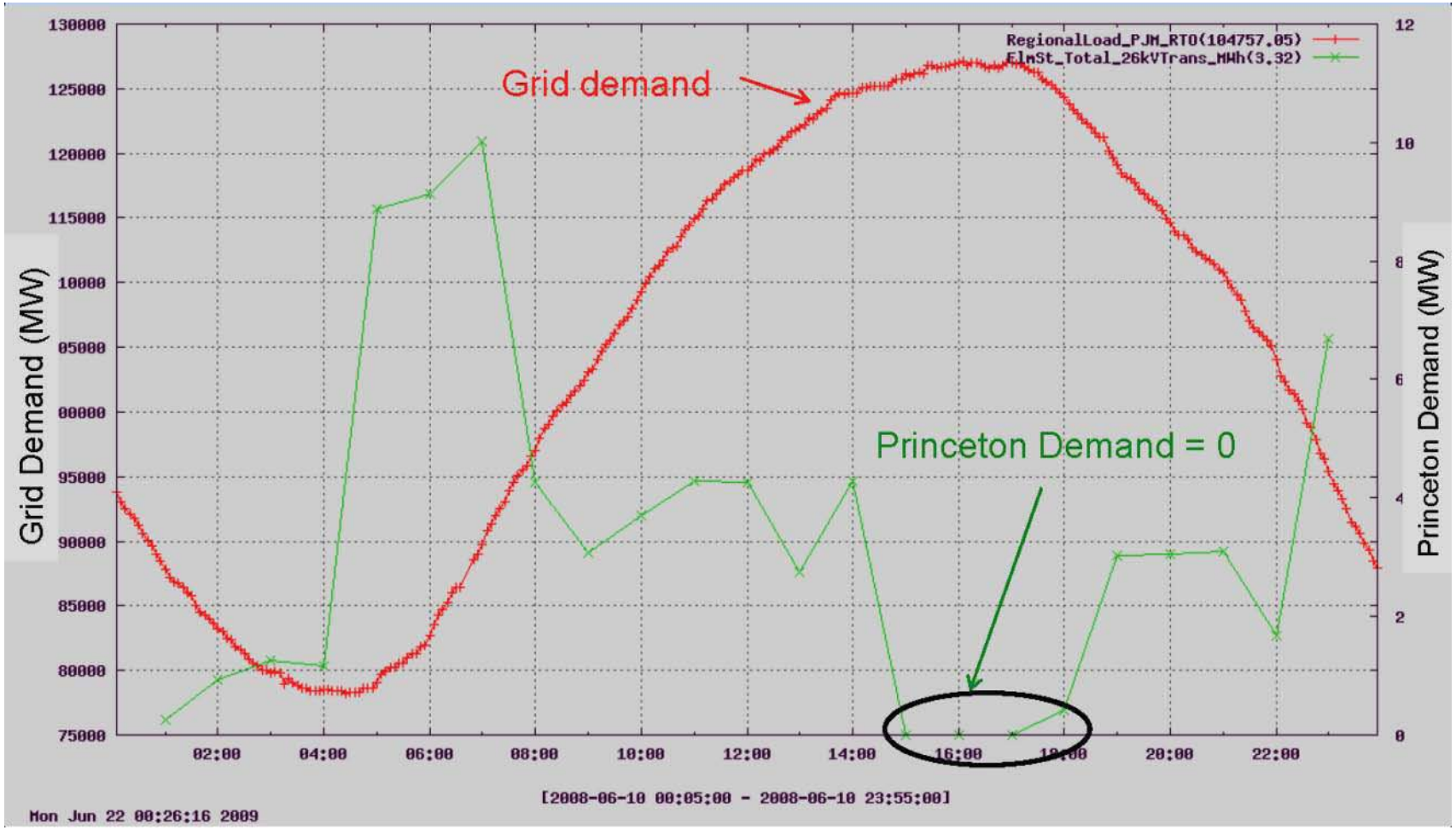
Princeton Load Shape



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The Parks at Walter Reed

- Multiuse development on former Army site
- DC defines utility by wires ownership
  - Exception for self supply
- Owners association (OA) owns the wires
  - Collective self supply
- Concession agreement with microgrid operator
  - OA leases wires to operator
  - Developer leases generating sites to operator
  - OA enforces the concession agreement

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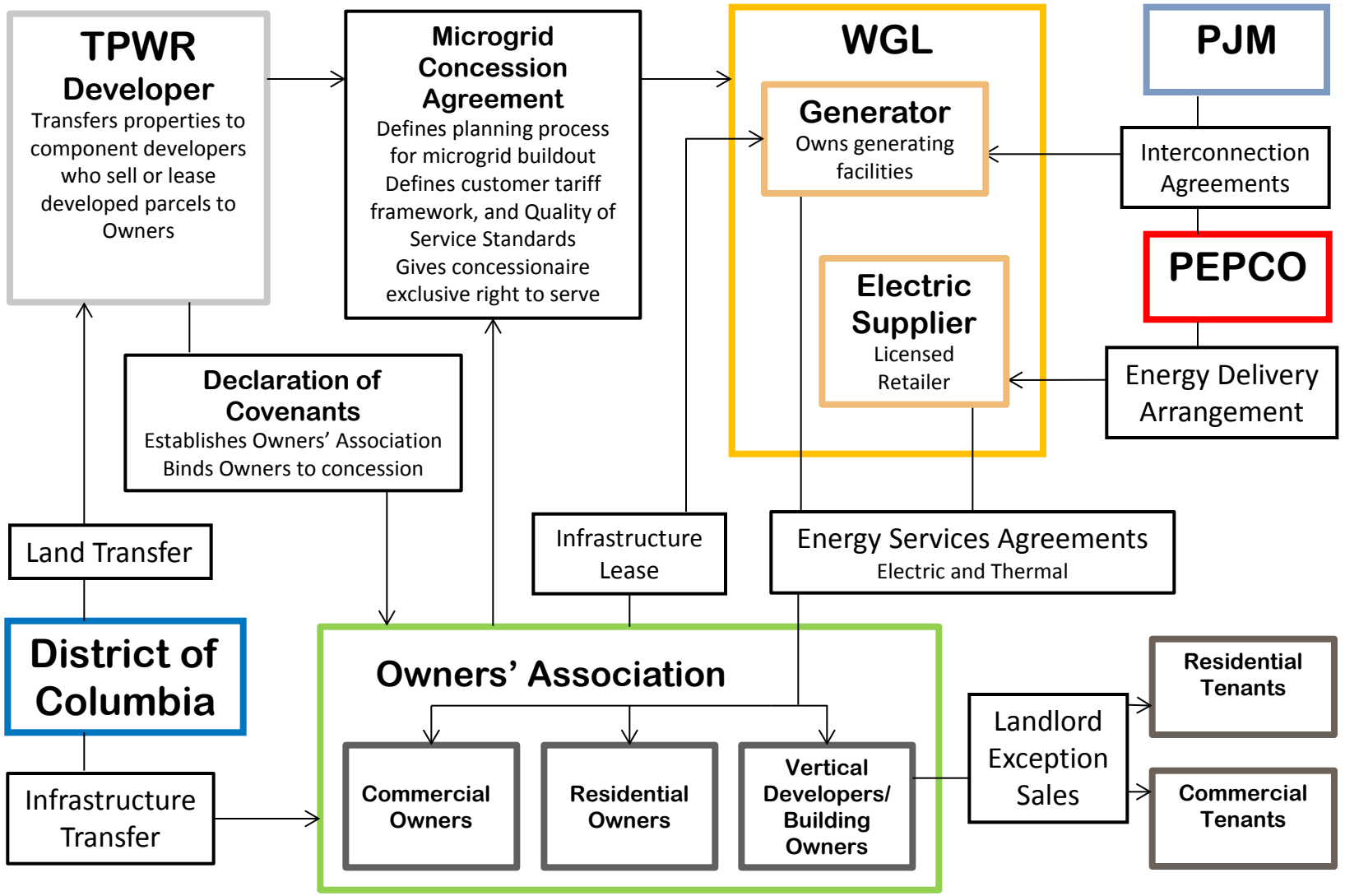
The Parks at Walter Reed – Microgrid Structure



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Brooklyn Microgrid

- Benefit Corporation will run a market for excess power generated by rooftop solar in a Brooklyn neighborhood
- Block-chain technology implemented through smart meters will set "peer to peer" price for solar
- Brooklyn Microgrid is a retail electric supplier
- Solar owners are "qualified facilities" under PURPA
- Utility bills customers based on Brooklyn Microgrid's settlement
- Future submarket microgrids will use cogeneration
  - Need to own wires or partner with utility to permit island operation
- Retail electric supply regulations form initial basis for partnership without additional negotiation

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Duke University

- Duke Power proposes to install a new cogeneration facility on the Duke University campus.
- The electric generation is owned by Duke Power, it is financed in rate base and is operated to optimize the utility distribution system
- The utility is permitted to own generation and there are no RTO power markets, only the utility
- Generation is paid for by ratepayers and operates for ratepayer benefit
- Duke University gets low cost thermal energy, and its payments reduce the cost for utility ratepayers
- Duke University can't use generation to optimize its system

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Borrego Springs

- San Diego Gas and Electric serves an isolated community at the end of a long feeder
- The community experienced repeated outages
- The utility installed islanding switchgear on the feeder and batteries in the community
- Other generation was added with third party ownership
- No "special services" are provided – the project allows the utility to provide reliable service
- Utility improvements are included in rate base

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PEPCO Maryland Proposal

- PEPCO agrees in merger to do public purpose microgrids
- Prince Georges County proposal would include County building, medical center, pharmacy, gas station and grocery store
- PEPCO will install islanding switchgear and controls
- PEPCO will issue RFP for included generation to be built and operated by third parties – will pay for some services
- Customers continue to have retail choice when the microgrid is not in island mode
- Proposed microgrid includes solar, batteries and gas generation
- No cogeneration proposed
    - Can RFP respondent's propose cogeneration and offer thermal services?

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Services to the Grid

- Wholesale markets
  - **Energy, capacity, ancillary services**
  - EPSA v. FERC has given FERC clear authority
  - Aggregators are the real market participants
  - Market sets the price
  - Resources must be visible and responsive
  - Bids not baselines
- Distribution support services
  - Avoid upgrading wires or substations, local peak support
- California PUC DER Planning Process
  - Map the locations on the **Distribution System** where DER can contribute

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Contracts and Pricing

- Conduct **Requests for Proposals** for DER solutions
  - Virginia unsolicited proposal model for transportation projects
- Distribution company enters long-term performance-based contract that serves as (partial) basis for financing
  - Penalties for failure to deliver
- Alternative is a fixed tariff or resilient resource credit rewarding resilient resources
- Hughes v. Talen Energy Marketing
  - States have broad power; can't interfere with wholesale market
  - Zero Emissions Credits upheld in courts

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New Utility Incentives

- Decoupling
  - Utility does not automatically earn all customer charges
- Incentive Ratemaking
  - Utility earns extra return for meeting specific goals:
    - **Reducing load**
    - **Interconnecting DER**
- Rate base treatment for DER contracts
  - Contract is a **"regulatory asset"** that earns a rate of return
  - Making the Utility indifferent
- Integration with wholesale markets

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Questions?

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