



Business Strategies for Stationary Fuel Cell Applications

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Stationary Fuel Cells

- BPA's EnergyWeb
- Overview of stationary fuel cell markets and regulations
- Business strategies
- BPA's Fuel Cell Program



What is BPA?

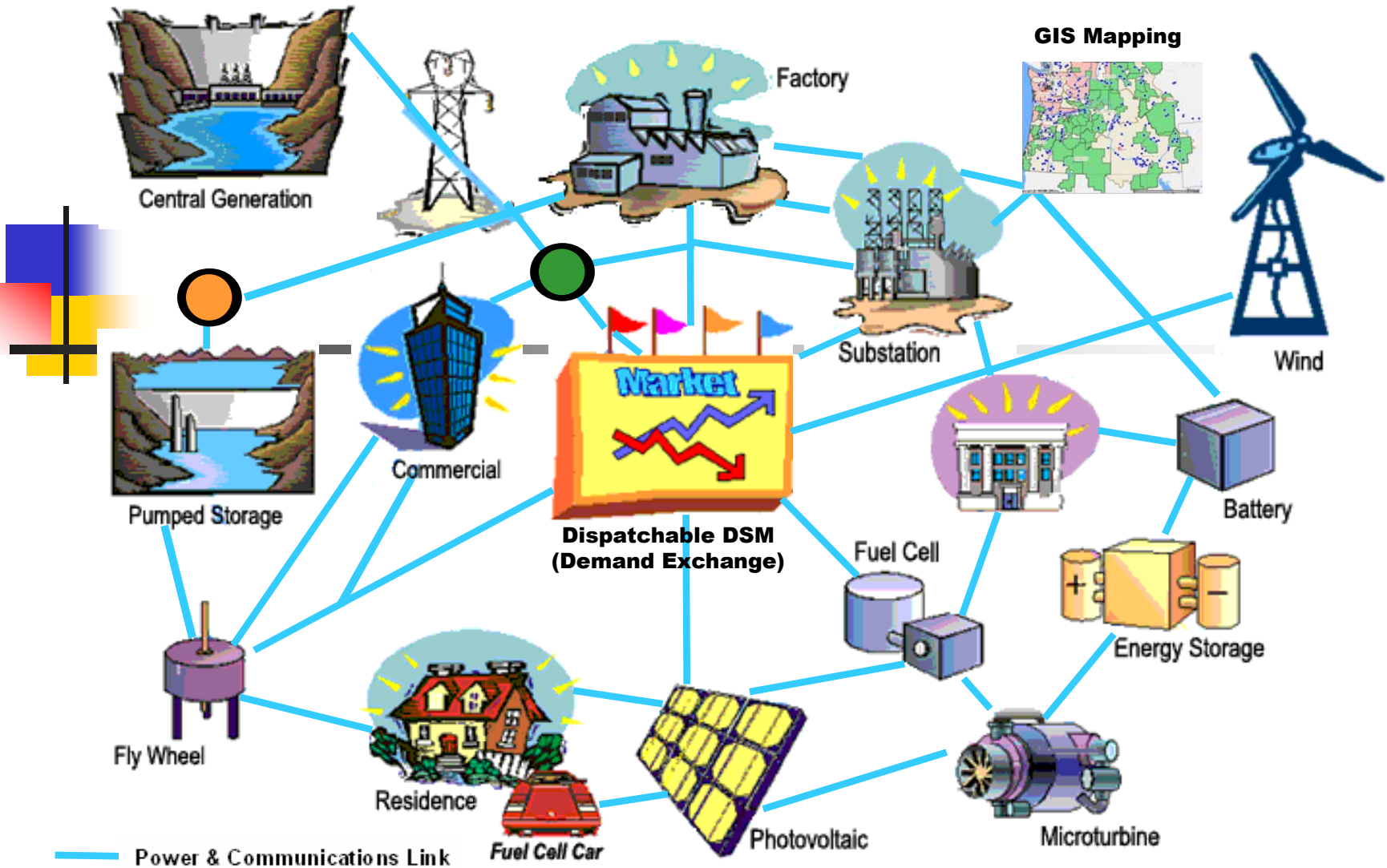
- BPA is a federal power marketing agency, serving the pacific northwest.



Why a BPA Fuel Cell Program?

- required to lower costs via R&D
by the 1980 Power Act
- Clean, simple concept, efficient, quiet,
supports green power
- Offset building new transmission lines
- EnergyWeb

EnergyWeb



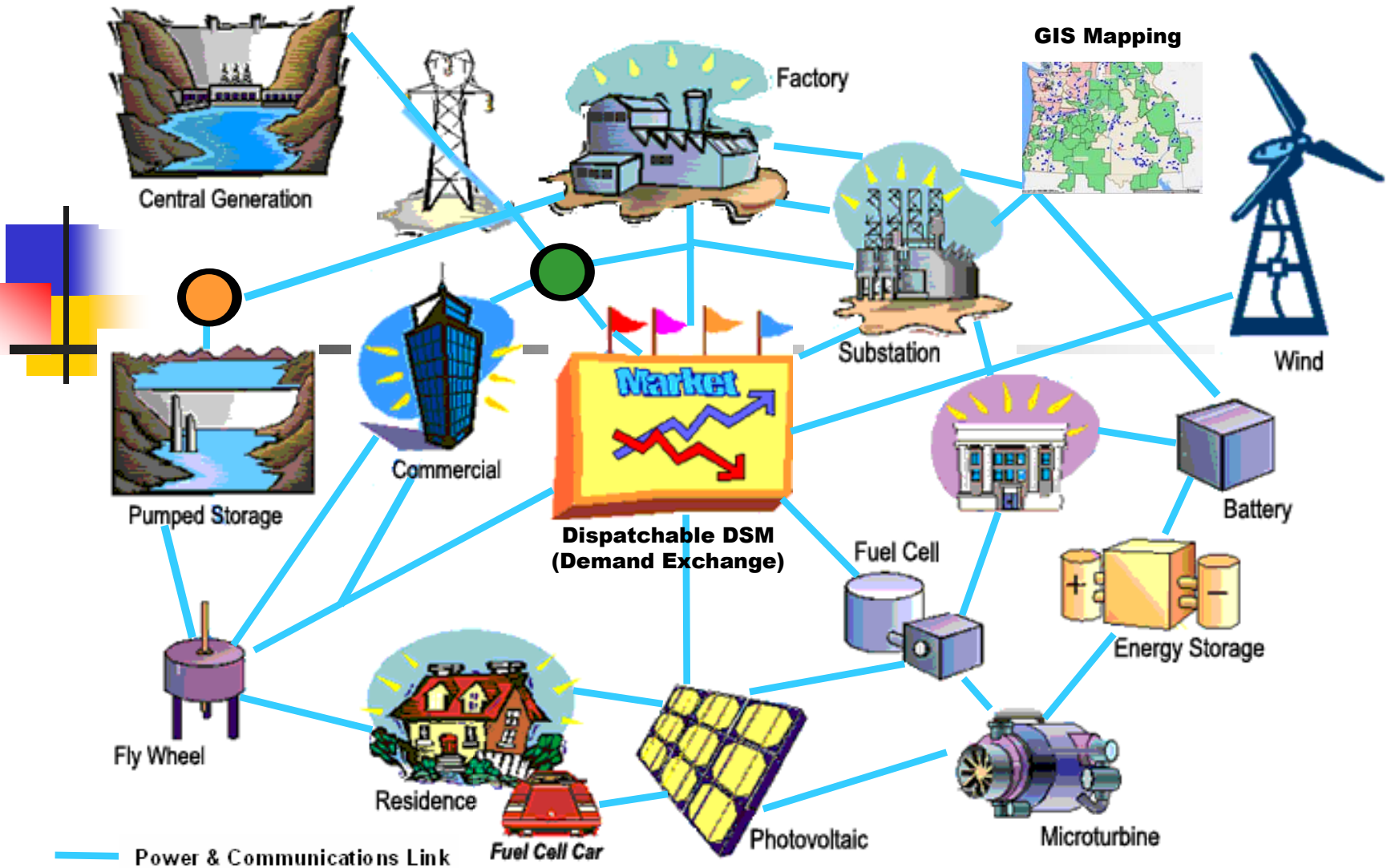


EnergyWeb definition:

The integration of the utility electrical system, the telecommunications system, and the energy market

- 1) to optimize loads,
- 2) reduce costs,
- 3) facilitate the integration of renewable resources,
- 4) increase electrical system reliability and
- 5) reduce environmental impacts of load growth.

EnergyWeb



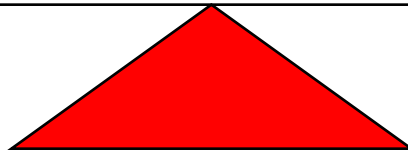


What is FERC's Standard Market Design?

- A uniform set of rules for the operation of the transmission grid and the wholesale electric markets nationwide.
- Intended to ensure all energy generators have equal access to the grid and equal economic compensation for their participation in wholesale electric markets.

Regional Transmission Operator Goal

- To create a robust, voluntary, demand-side market for ancillary services, including distributed generation.



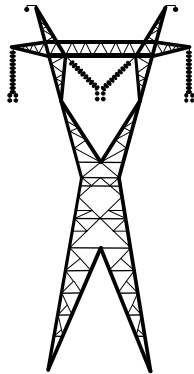


RTO Potential Ancillary Services

- Regulation and Frequency Response service;
- *Load Following Up service*
- *Load Following Down service*
- Spinning Reserve service
- *Non-spinning Reserve service*
- *Balancing Energy*
- Voltage Support
- *Black Start service*
- *Congestion Re-dispatch service and*
- Local Generation Resource ("LGR") **which include fuel cells!**

Are fuel cells a disruptive technology?

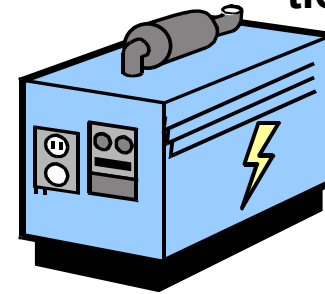
The Grid



- Low Cost
- Convenience
- Status Quo
- Predictability

Hey, we're reliable!

Distributed Generation



- Self-sufficiency
- Flexibility
- Cogeneration
- Reliability (?)

Hey, we're new!

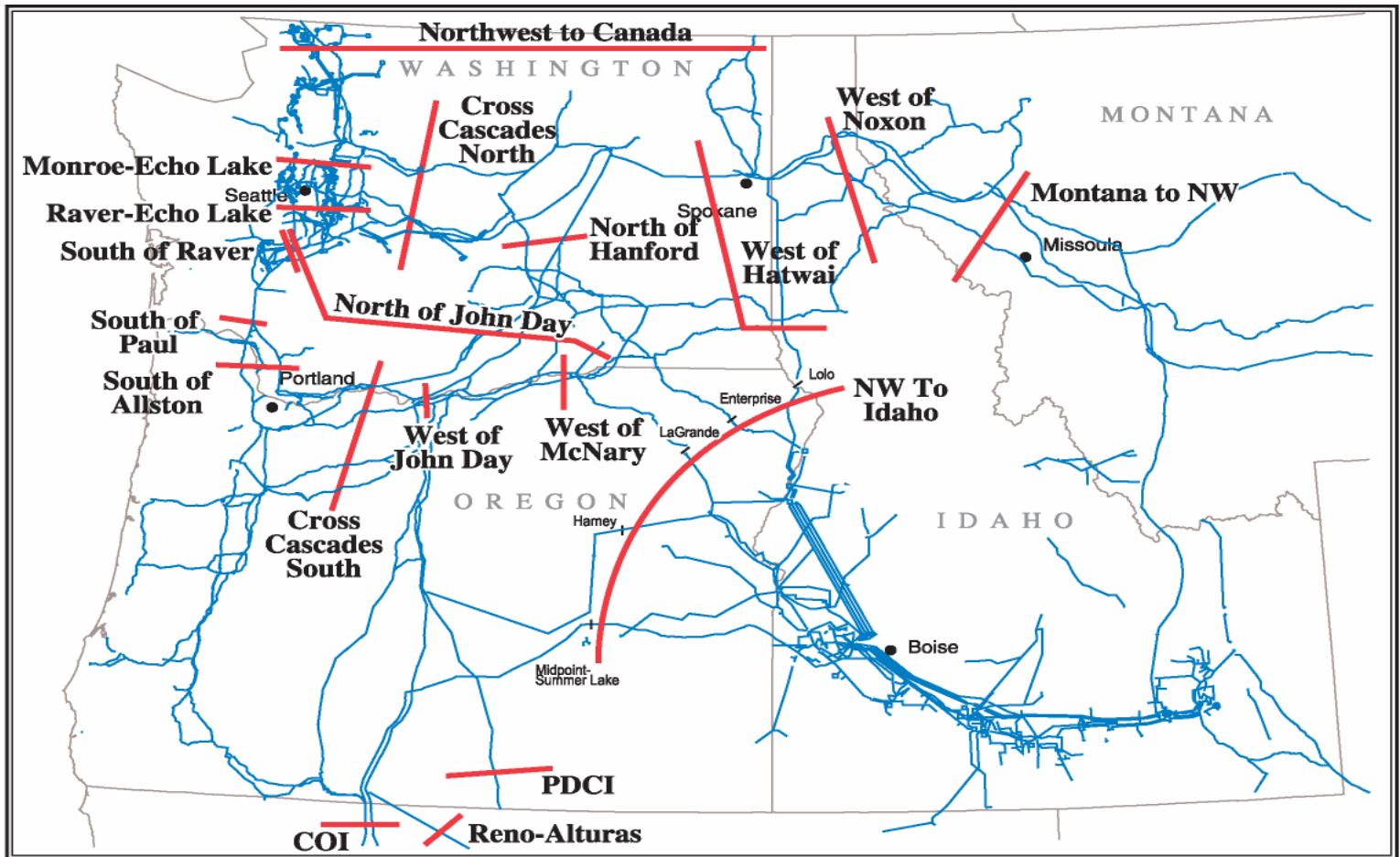




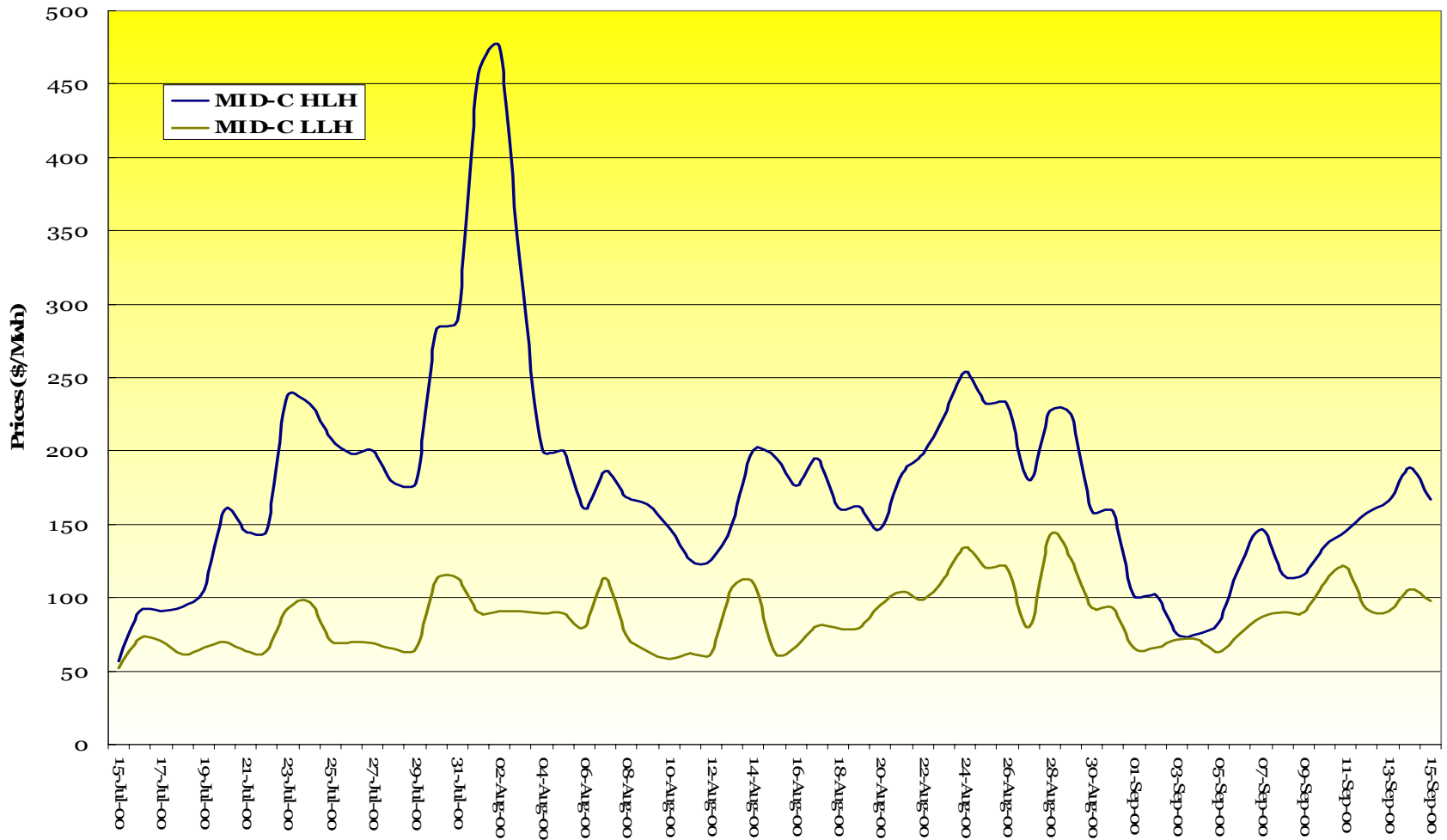
What can fuel cells

do for the Grid?

Reduce loads on constrained transmission paths



Reduce daily and seasonal peak loads



The Demand Exchange SM

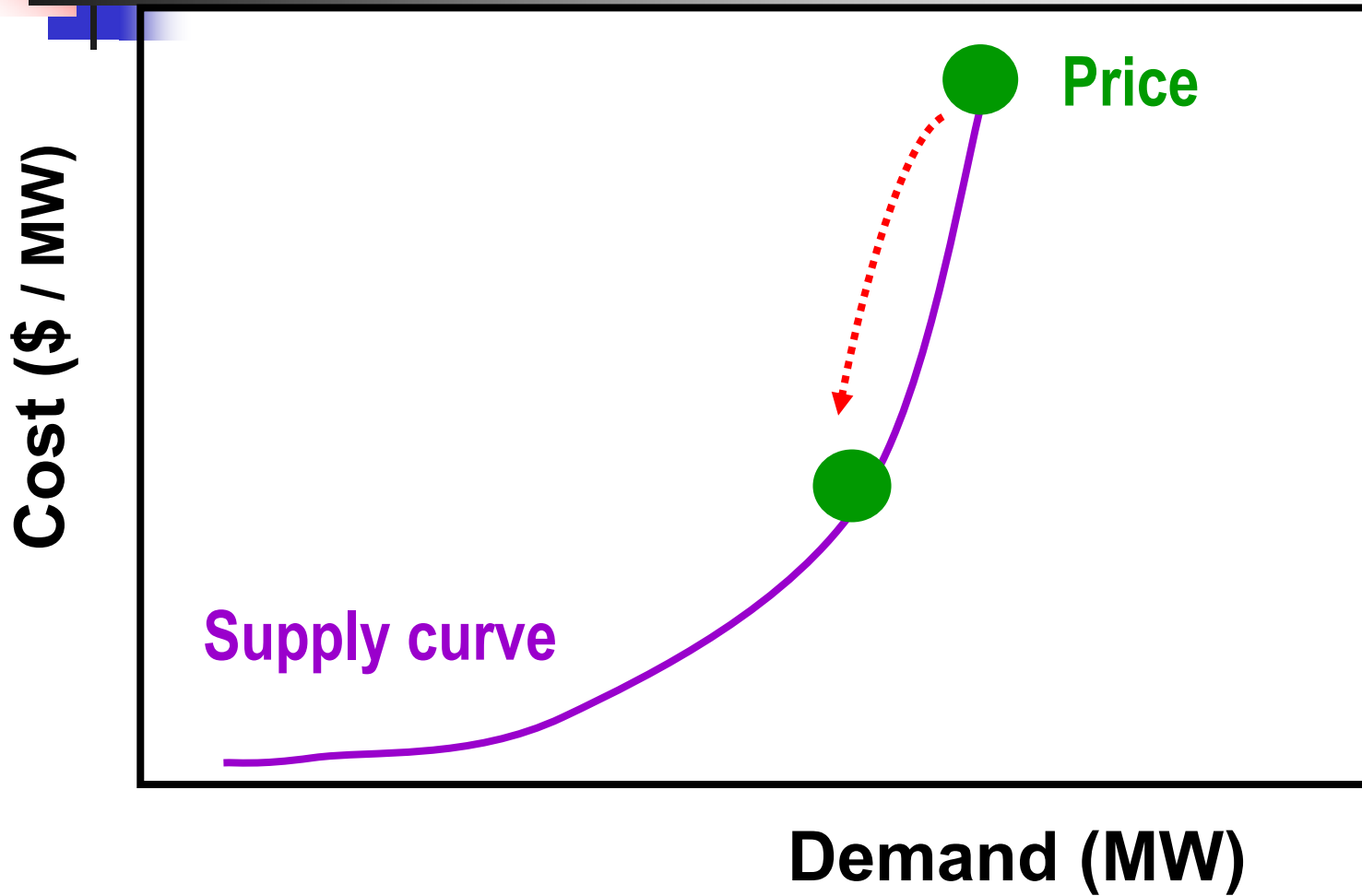


**BPA's Peak Load Management Program
for selling energy back to the grid.**

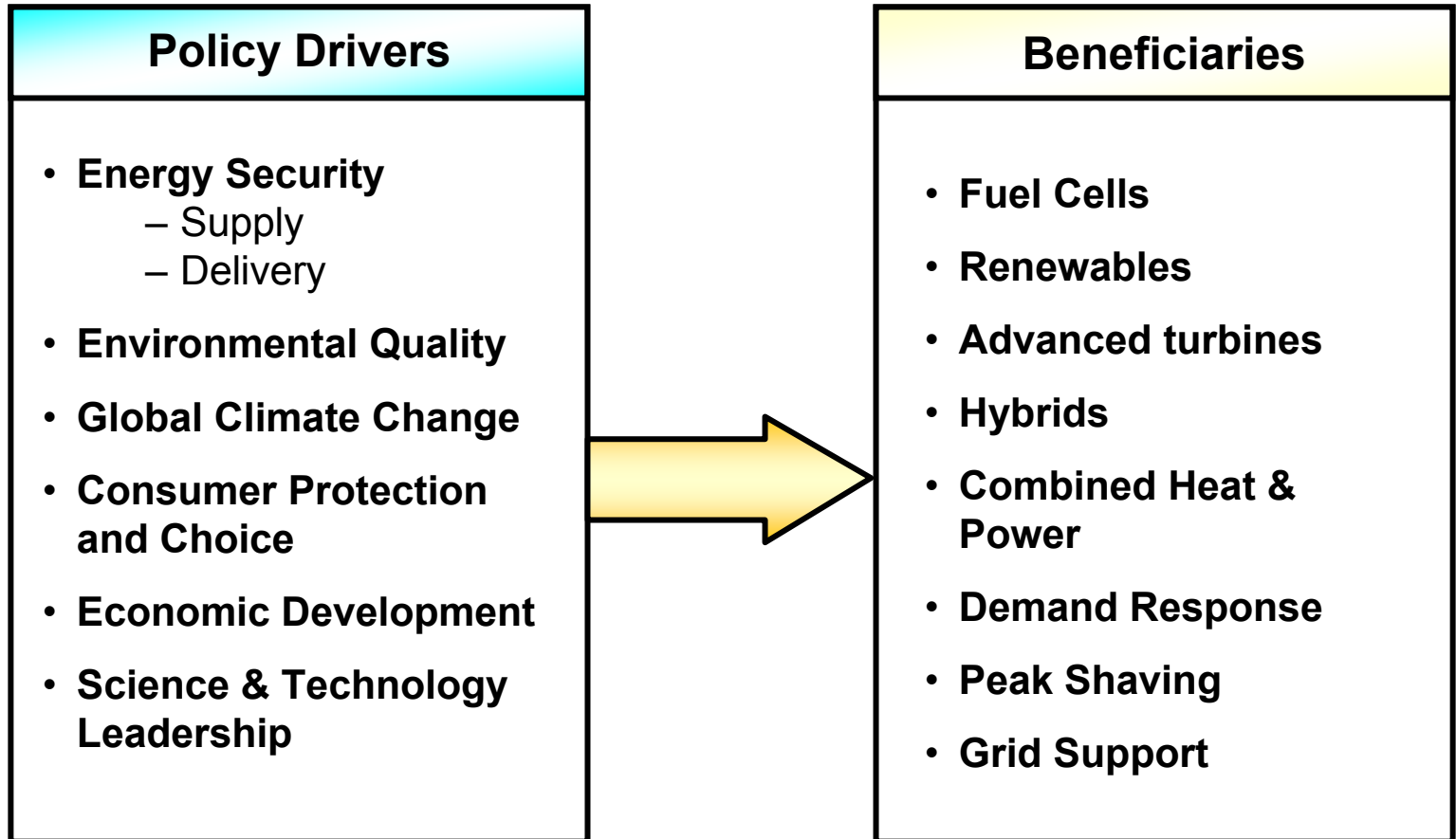
Brad Miller, Program Manager

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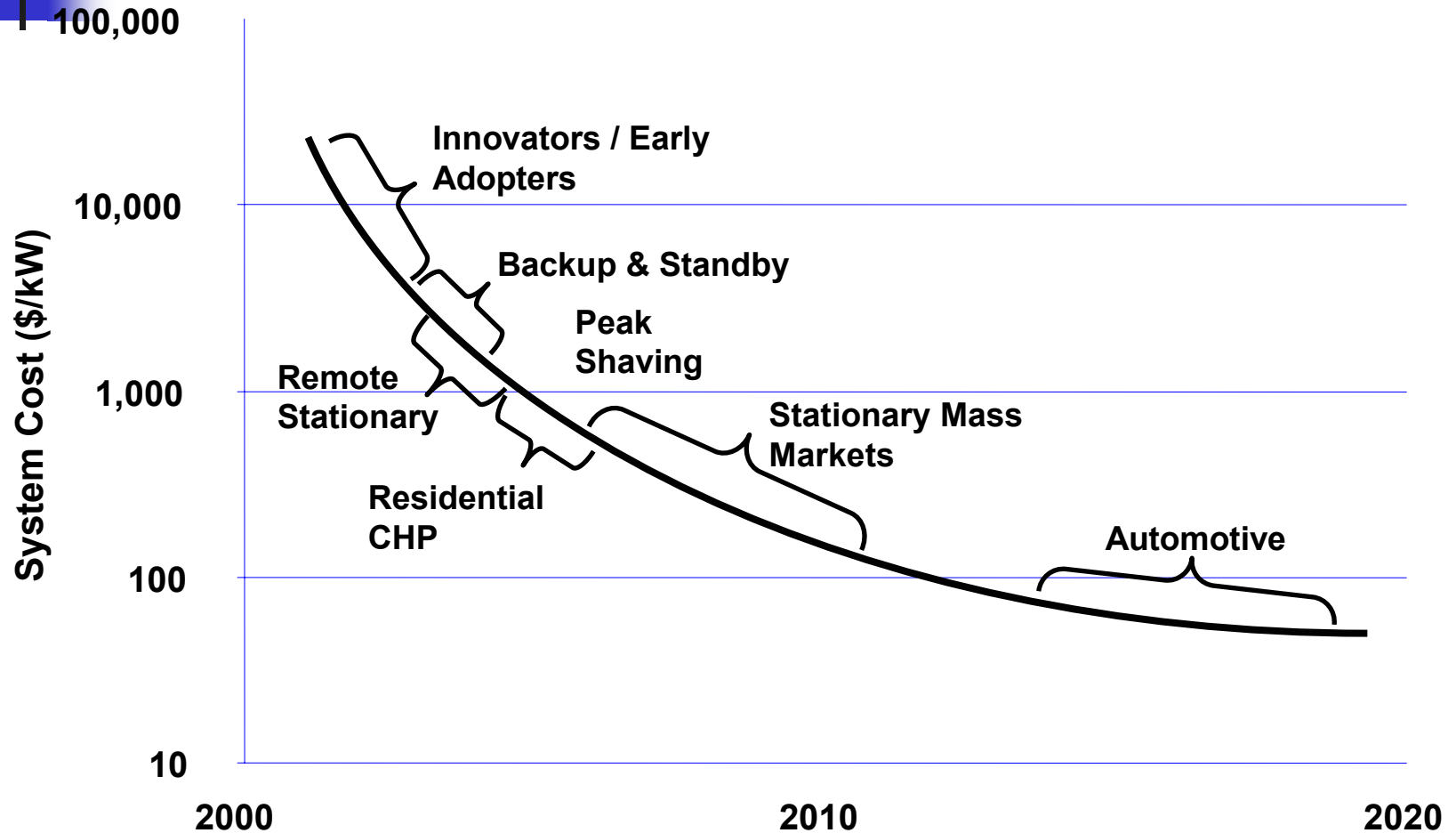
Value of Demand Elasticity



What are the policy drivers for DG?



Possible fuel cell adoption curve





Business Strategies



What Business Model will be the most effective?

- Lease or sell?
- Will 3rd party vendors package into “plug-and-play” systems?
- IBM or Gateway?
- Will partnerships be formed with fuel providers?



Business Opportunities

- Fuel cell manufacturers
- Energy service companies (ESCO's)
- Utilities
- Electrical installation/service companies
- Retail companies



Aggregating Business Segments

- Electric Utility Service Areas
- Climate
- Customer Size and Type



Strategic Business Issues

- Who will reduce costs first?
- How will codes and standards affect your product?
- When will size and designs be standardized?
- What will be the preferred fuel?
- Will incentives continue to be available?
- Will manufacturers be responsible for their product from cradle to grave?



Customer Service Issues

- Owners want all-inclusive warranties, 24/7 customer service and in-depth training
- Modular design
- “User” Groups with Web-enabled data for comparison
- Communication protocol for remote troubleshooting and grid connection



Consortium for Electric Infrastructure for a Digital Society (CEIDS)

Goals:

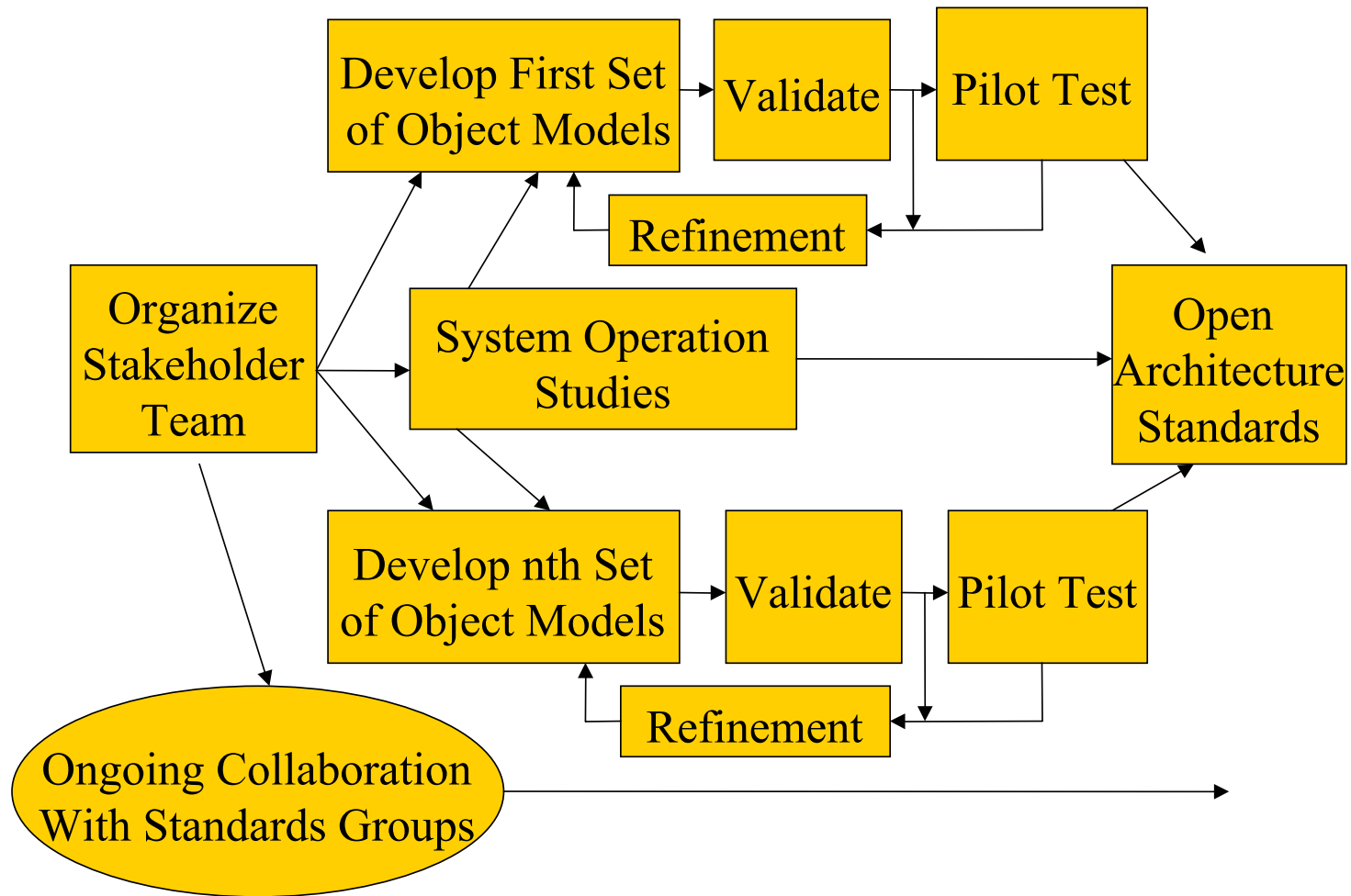
- Develop, validate and test communication models for grid connection, real time scheduling and remote dispatching of DG
- Coordinate with others for industry standardization



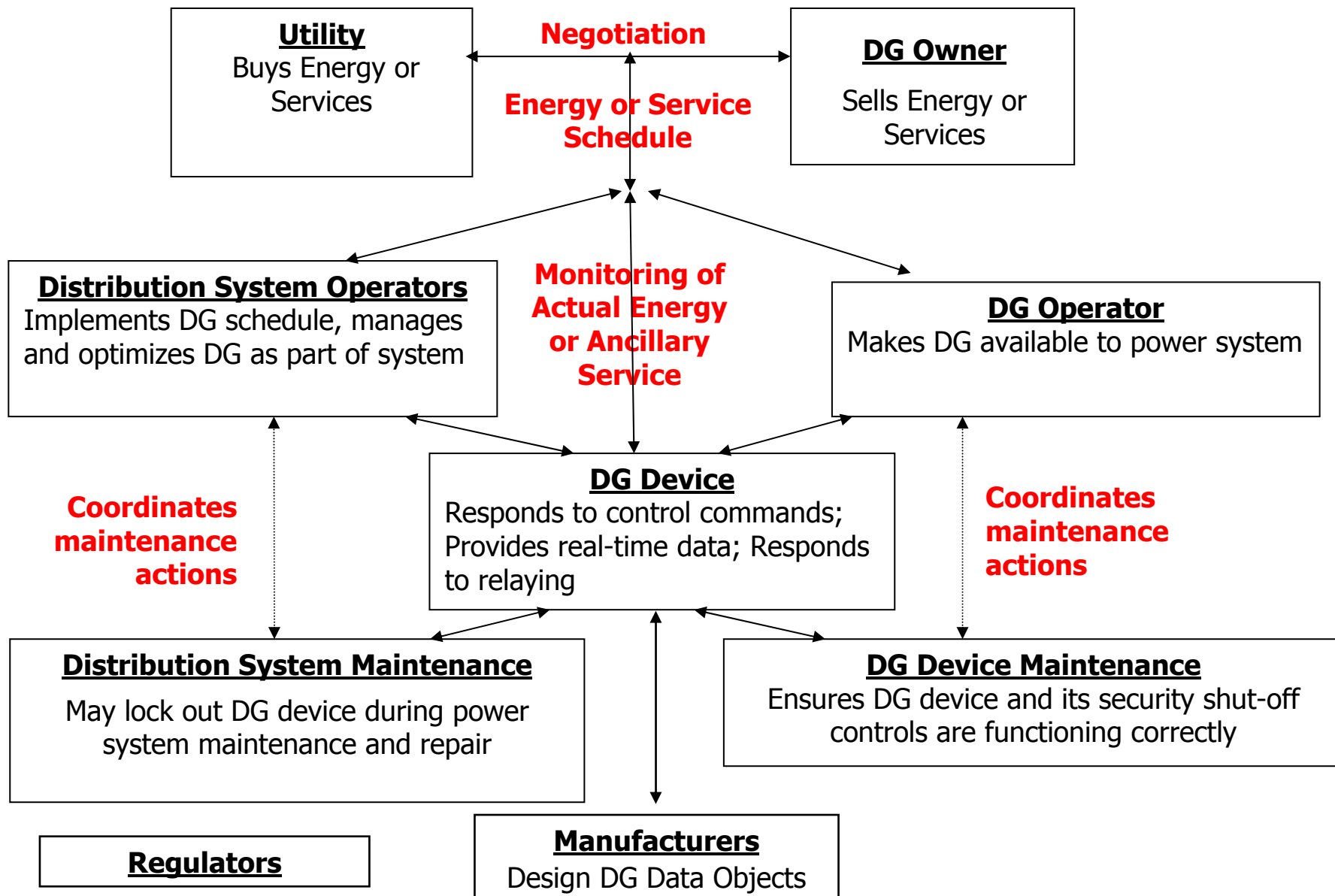
What could the DG Data Object include?

- On / off status
- Automatic or Manual mode
- Operational or off-line
- Ready to be connected to load
- Connected or disconnected from load
- Base load or load following
- Connected to grid or stand-alone
- Ready to be synchronized to grid, or not
- Status: starting, generating or shutting down
- Alarms: high/low voltage, high/low frequency, emergency trip, etc

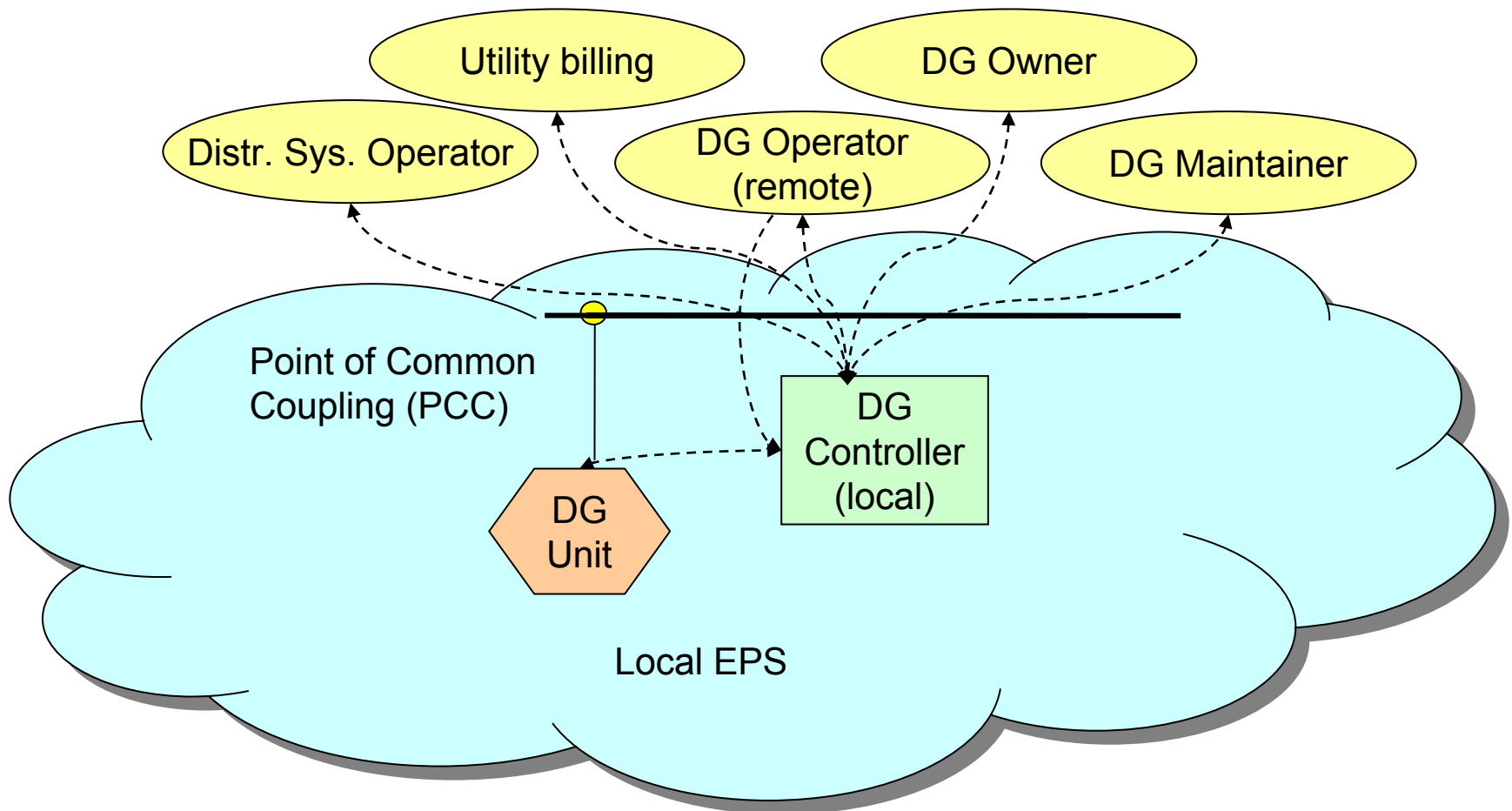
Flowchart of CEIDS Process



Who are the CEIDS Stakeholders?



Real Time Information Exchange





BPA's Fuel Cell Program



BPA's Fuel Cell Program

- **Goal:** To accelerate the commercial availability of fuel cell technology.
- **Objectives:** To identify and address barriers to fuel cell technologies and to ensure commercial systems meet the needs of our Customers through field testing pre-commercial systems.



BPA Program Accomplishments

- Field tested 16 PEM fuel cell systems,
- Active Steering Committee,
- Participate in USFCC Codes and Standards Committee,
- Co-sponsor DG Code Workshops,
- Part of NW Combined Heat and Power Consortium and
- Participating in fuel cell education and outreach activities.



Plug Power's GenSys 5CS Unit

- PEM
- 5 kW
- Natural gas
- Grid connected
- Heat recovery capability
- Listed only for exterior installation



Global Thermoelectric/Quantum Beta Units

- Planar solid oxide
- 2 kW and 5 kW units
- Natural gas or propane fuels
- Grid connected
- Future heat recovery capability



Characteristics for niche applications

- Start-up time
- Operating temperature
- Operating environment
- Effects of cycling
- Fuel flexibility
- Heat recovery capability
- Efficiency
- Repair/replacement times and costs
- Effective life



Stationary Fuel Cell Code Restrictions

- Several Cities don't allow aboveground tanks
- Even prototype units need to be 'listed'
 - field labeling is expensive and time consuming



BPA's Program Future

- Continue gathering field data;
- Balance BPA's current financial constraints and the state of the technology;
- Field test a variety of systems using different fuels.