Distributed Resources

Has the Time Come to Start with the User?
Some California Lessons

- Wholesale competition is not simple
- Supply and Capacity are not the same thing
- Demand response is a must
- Reliability at point of use becomes critical
- Difference between emergency and distributed generation blurs
- Portfolio of resources still needed for risk and price management
What is the Goal?

- Clean, Abundant, Affordable Electric Supply Tailored for "Smart" Efficient Customers

"Events in California have demonstrated the nation's existing electricity infrastructure cannot adequately meet the new Economy's need for high amounts of reliable computer grade electricity"

Energy Options Seminar, Silicon Valley Manufacturers Association

- Can't get to the goal without considering Distributed Resources - Regulated or not
Distributed Resources

- Gensets
- Photovoltaics
- Microturbines
- Efficiency (DSM)
- Fuel Cells
- Wind
- Storage
- Energy Management
- Information

Connected to Distribution Grid
Average Size of Power Plants
Utility and Non-Uility

17,690 Power Plants (1920-1994)

Ref: Dusky, Phillipe Cogeneration and On Site Production Nov - Dec 2000
What Role Can Distributed Resources Play?

- Provide innovative choices for customers
- Provide least cost or highly valued services
- Increase reliability, reduce environmental impact
- Provide competitive pressure on Distribution Cost
- Provide competition for Wholesale Costs
- Provide Alternative to T/D Upgrades
- Change Distribution Networks (Microgrids)
Characteristics of Distributed Resources?

Provide Energy Services at the Distribution System or the Customers Premise

Requires special focus on the Retail Market Rules or Regulations

Compete with Price or Value at the Point of Service not the Price of the Spot Market or Busbar
# What's in the Black Box?

<table>
<thead>
<tr>
<th>Technology</th>
<th>Status</th>
<th>Power Range</th>
<th>Efficiency</th>
<th>Cost Range</th>
<th>Emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microturbines</td>
<td>Near Commercial</td>
<td>5 to 250 kW</td>
<td>20 - 40% Efficient</td>
<td>900-1300 $/kW</td>
<td>0.4-1.2 lbs/mWh NOx</td>
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<tr>
<td>Photovoltaics</td>
<td>Commercial</td>
<td>1-300+ kW</td>
<td>6-20% Efficient</td>
<td>5000-10000 $/kW</td>
<td>None</td>
</tr>
<tr>
<td>Fuel Cells</td>
<td>Near Commercial</td>
<td>5 to 1000 kW</td>
<td>35-55% Efficient</td>
<td>1300-3000 $/kW</td>
<td>0.01-0.02 lbs/mWh NOx</td>
</tr>
<tr>
<td>Wind</td>
<td>Commercial</td>
<td>10-1000 kW</td>
<td>25% Efficient</td>
<td>850-3500 $/kW</td>
<td>None</td>
</tr>
</tbody>
</table>
Major Issues in Distributed Resources

Show Me the Problems
Safe, reliable, interconnect, don't crash the system
Siting, inspection, certification, managing

Show Me The Money
Costs, benefits, whose-utility, customer, company
Who gets what, when why, including information
Will unravel the cost structure of distribution

Show Me The Clean
Emissions, better or worse, depends
Regulation emerging

Show Me The Future
Potential Design and Changes
Opposing approaches to nontechnical issues

Plug and Play - Distributed Generator meets all consensus technical standards. Burden of proof that there is a problem rests with the Electrical Distribution Company (Texas?)

(California - in the middle?)

Hesitate and Hassle - Distributed generator meets all consensus technical standards. Burden of proof there is no problem rests with the Generator (New York?)
Net metering

Net Metering now in 30+ States
Is it an indicator of social consensus?
   Bills signed by both Republican and Democratic Legislatures and Governors

"If an American wants to generate he or she ought to be able to"

Types of generation, size, capacity cap and conditions are different for every State
   FERC ruling - Exchanges not Sales
Information Everywhere

The Four C's

A Chicken in every pot, a Car in every garage, a Computer in every school, and a Chip in every appliance.

We are moving to be able to connect to every appliance by wire or wireless.

The language is available - Jini - Java based

The Internet becomes the common information carrier
Show Me the
Clean Air Emissions

- Texas Rules in Final Review
- California Special Working Group
- Regulatory Assistance Project Collaborative

Major Issues

Better than the average or better then the best
Credit for use of heat, efficiency, renewables
Difference between emergency and distributed
The Future?
Starting from the User

Design Criteria
- Reliability of distribution grid specified by regulator
- User chooses reliability and quality above specification
- User chooses emergency function when grid is down
- Peaks are managed close to user, Central stations mostly baseload
- Local Grids maintained when large grid is down

User Solutions

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Information Linkage

RTO / ISO
Aggregated

User
Differentiated

Manager
Supply

Manager
Demand

Generator

Substation
(Generator)

Customer

Wholesale

Retail

Efficiency

WEINBERG ASSOCIATES
Driving Intelligence Down Into the Distribution System

The Substation as a Flexible Energy Management Facility

The Distribution System

Transmission

Smart Substation ±gs

Interactive Gateway

Choices

Customer ±gs

Customer ±gs

Driving Intelligence Down Into the Distribution System
Large Grid is Connected Minigrids
Electrical Industry Scenarios

Triumph of the Good Old Boys
- Slow
- Diffused
- Little R&D
- Unproven

Teaching Old Dogs New Tricks
- Regulated Monopoly
- Vertically Integrated
- Cordial
- Regional groups
- Slow transition

New Gladiators Old Weapons
- Rapid
- Focused
- R&D Investments
- Proven (Demos)
- High Smarts Integration
- Clean Focus
- Distributed

The Supermarket of Choices
- Open/Free Competition
- Cutthroat
- International
- Value Added
- Quick Transition
- Differentiated Energy Services

TECHNOLOGICAL INNOVATION

INDUSTRY STRUCTURE