

Enhancing DG Participation in the Deregulated Marketplace Using Intelligent Software Agents

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**Alternative Energy Systems
Consulting, Inc.
(AESC)**

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Presentation Agenda

- ◆ *CEC-PIER Project Background*
- ◆ *What is an Intelligent Software Agent?*
- ◆ *Smart*DER Technology - An Agent-Based Approach to DG Asset Aggregation*
- ◆ *Smart*DER Demonstration Software*
- ◆ *Follow-on Demonstration Project*
- ◆ *Summary*

CEC-PIER Project(s) Background

- ◆ **California Energy Commission (CEC) - Public Interest Energy Research (PIER) Program**
 - “Intelligent Software Agents for Control and Scheduling of Distributed Generation” (CEC-PIER 500-98-040)
 - ★ Awarded in 1998
 - ★ Work began in June 1999
 - ★ Work completed in February 2001
 - AESC was recently awarded a follow-on contract (CEC-PIER 500-00-016) for a demonstration field test during 2002.
 - See www.aesc-inc.com for additional information.

CEC-PIER Project Need

The CEC recognized that:

- ◆ DER assets could play a significant role in a competitive energy market but there were significant barriers to the use of this technology.
- ◆ Making use of DER technology on a large scale requires control and scheduling of large numbers of distributed assets -- yet the centralized decision and control paradigm employed in the electric power industry was ill-suited to this task.
- ◆ Intelligent agent technology was a potential solution.

Intelligent Software Agents?

An *agent* acts on behalf of another....

An *Intelligent Agent*

- Executes autonomously & operates in real-time
- Communicates with other agents or users
- Able to exploit domain knowledge
- Exhibits goal-oriented behavior

Agency Advantages:

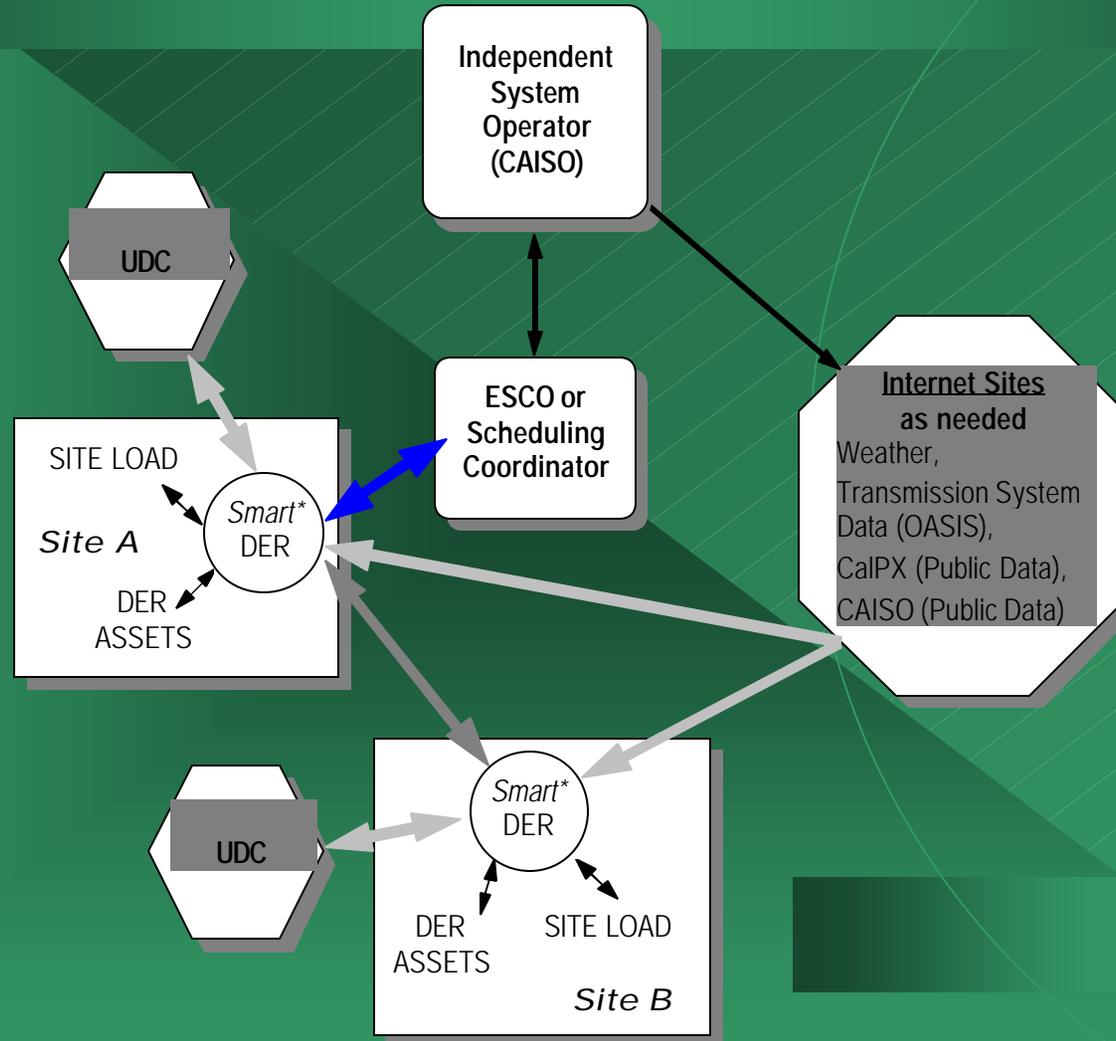
- Multi-agent systems (a.k.a. Agency) allow distributed processing
- Agent complexity is kept low while agency intelligence is high
- Agent-based solutions are more open and extensible

Why Use Intelligent Software Agents?

DER scheduling / aggregation is amenable to an agent-based solution because:

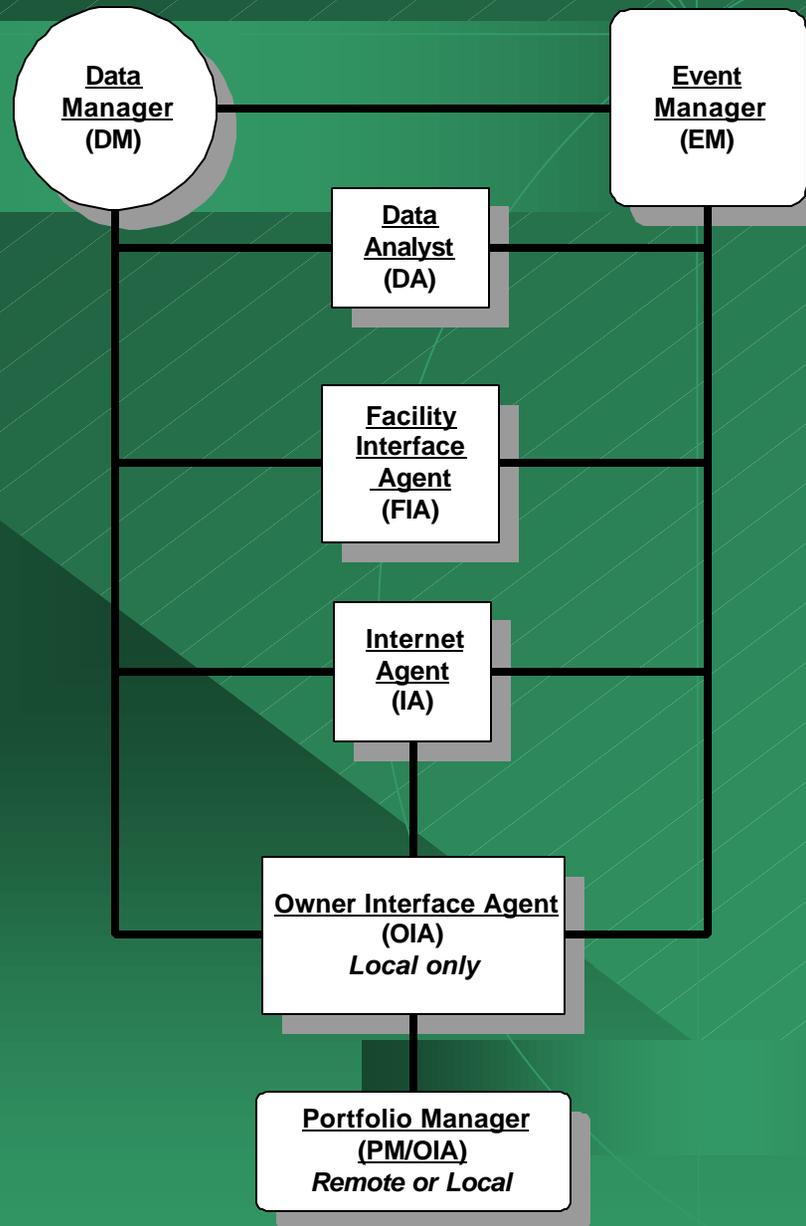
- An open / extensible solution is needed
- DER benefits are application & location specific requiring local knowledge and decision-making
- Information comes from a variety of disparate sources
- Aggregation of loads/supplies requires communication / collaboration between sites
- A dynamic decision-making environment exists
- In many instances there is insufficient local expertise to consistently handle the day-to-day decision making

Smart*DER Operating Scenario



Smart*DER Agency

- ◆ Task analysis yielded seven independent agents, each devoted to a single aspect of the scheduling / aggregation process
- ◆ Java based code & Internet-based communications
- ◆ Individual agents can be located on the same or multiple platforms



Benefits & Efficiencies

- ◆ *Site / application knowledge & associated inputs reside at each site.*
- ◆ *System is easily expanded - new sites automatically register with the Portfolio Manager (PM) agent - no PM programming or algorithm changes are needed.*
- ◆ *Any site can be configured to manage the portfolio*
- ◆ *User provides basic system constraints but once configured there is little in the way of routine decision input from on-site personnel (if allowed).*
- ◆ *Bottom line -- This gets us closer to “plug and play”*

*Smart**DER Demonstration Software

- ◆ **Demonstration software was developed as part of the initial CEC-PIER project to facilitate technology transfer.**
- ◆ **Demo Software Uses:**
 - CAISO & CalPX price data for 1999 calendar year
 - San Diego area weather data & generic commercial, industrial and residential load profiles (SDG&E)
 - Internet based data supplied by a single website that emulates CAISO and CalPX functions
 - A single complete agency per PC (demo purposes)
 - Microsoft Access DB, which limits it to the Windows OS

Smart*DER Demonstration Example

- ◆ **Two Sites / Four Generation Assets**

 - Small Commercial with 175 kW of Installed Capacity*

 - Large Commercial with 400 kW of Installed Capacity*

- ◆ **Unit Operation Options**

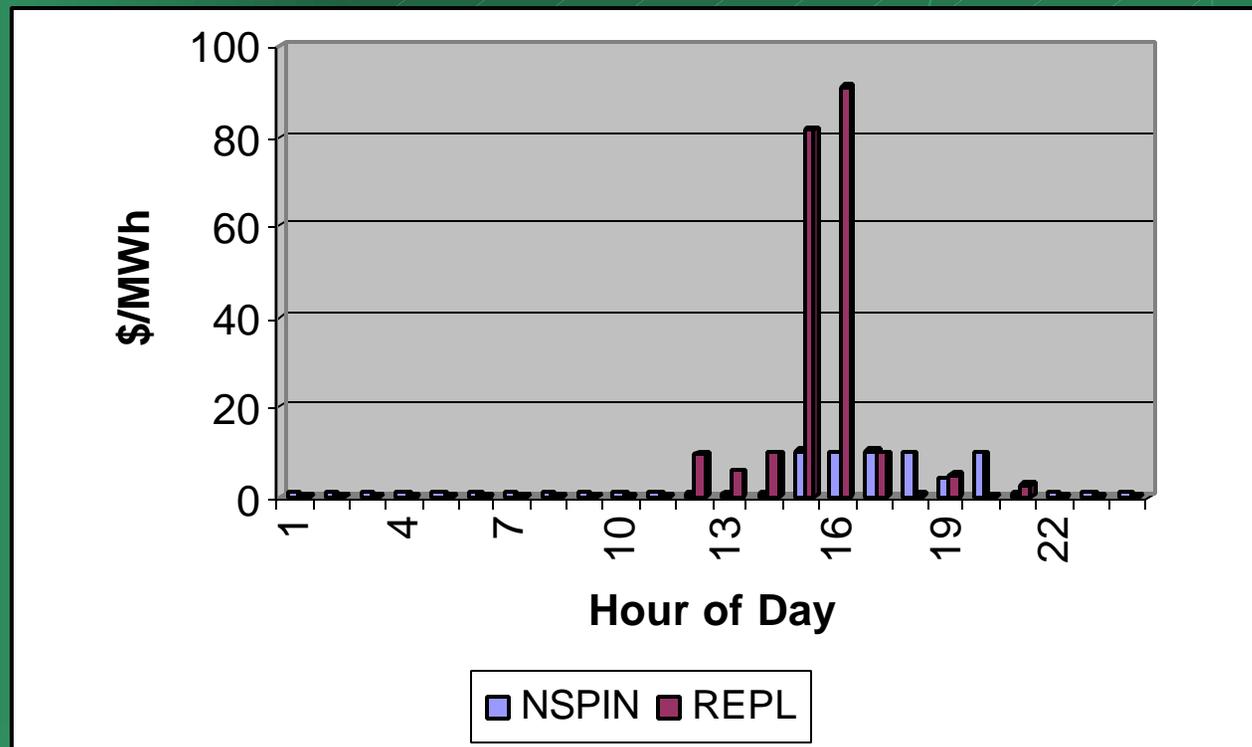
 - No operation*

 - Operate to displace site load*

 - Sell capacity into AS markets (NSPIN, RR) - Operate to supply AS if called*

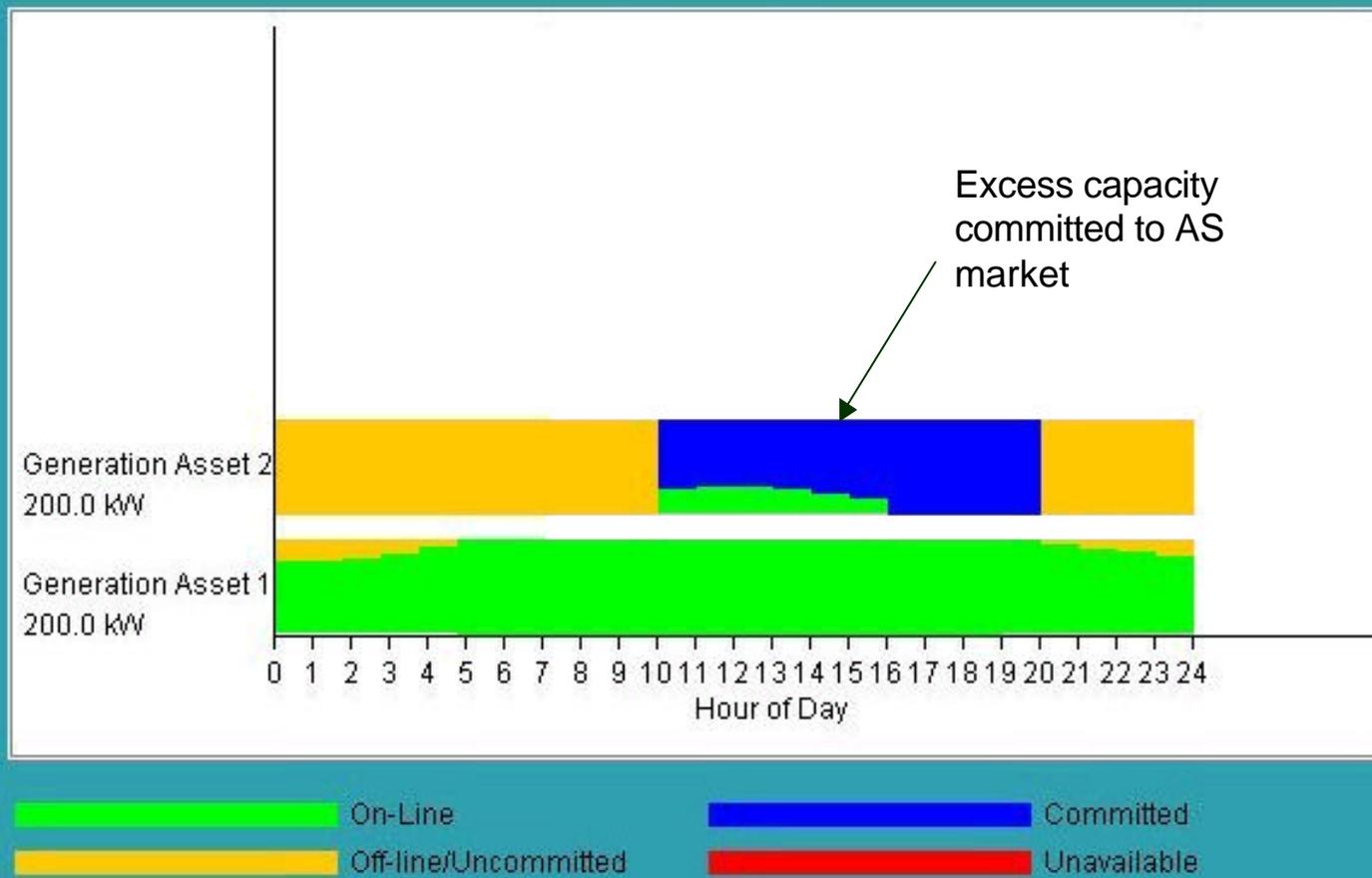
Demonstration Day Pricing - 9/28/99

Ancillary Services Pricing



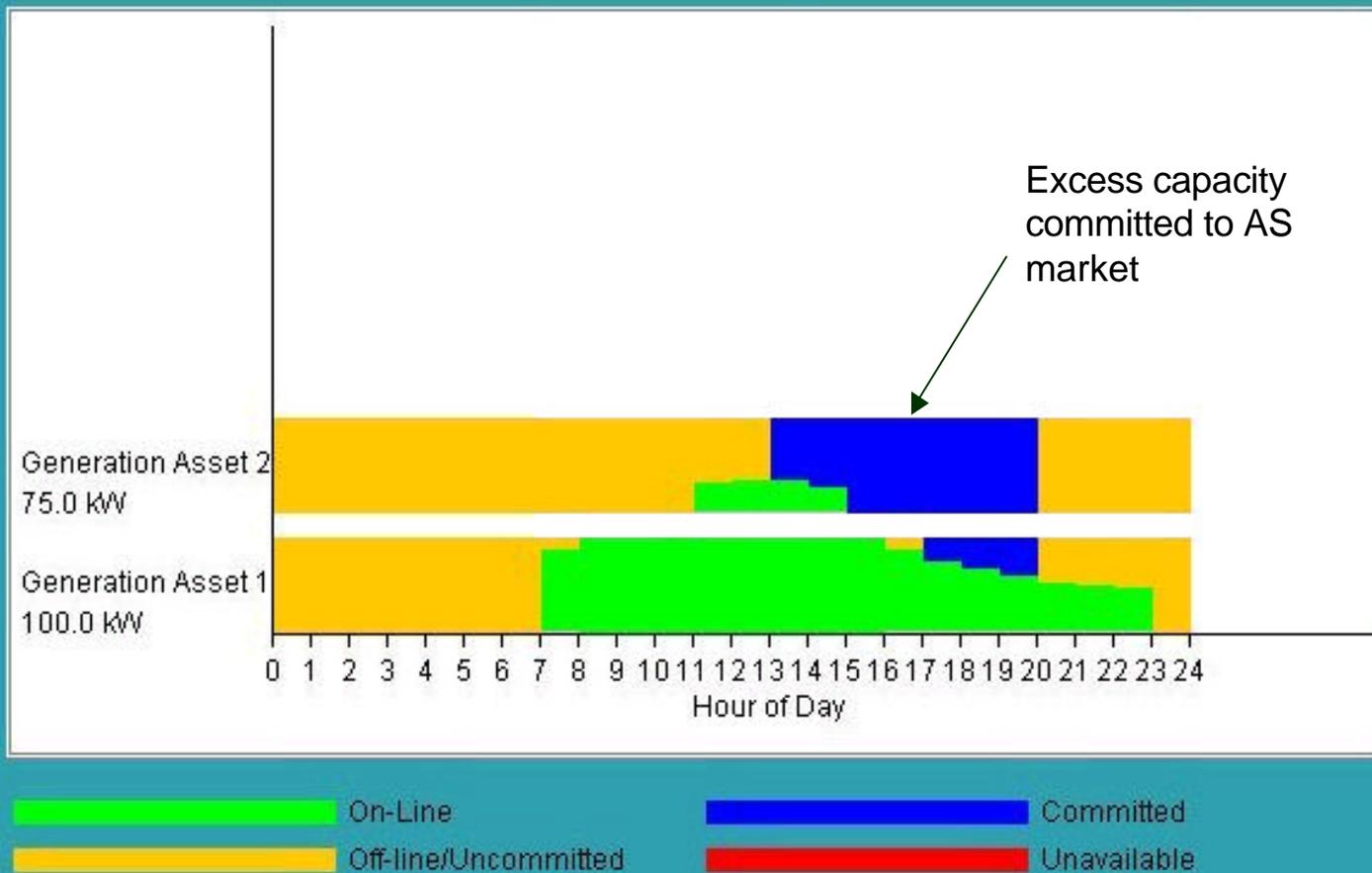
Asset Status/Schedule - 9/28/99

400 kW Installed Capacity - Large Commercial Load Profile



Asset Status/Schedule - 9/28/99

175 kW Installed Capacity - Small Commercial Load Profile



Follow-on Project Description

During the follow-on project AESC will:

- Update *Smart*DER* product requirements based on changes in the California energy marketplace.
- Enlist participation by one or more potential commercialization partners
- Refine / update *Smart*DER* technology
- Use *Smart*DER* technology for DER scheduling in the “real world” California marketplace during 2002.

Summary

- ◆ Opportunities exist for DER involvement in the dynamic California marketplace.
- ◆ CEC-PIER project results showed that intelligent agent technology (*Smart*DER*) can be used to schedule and aggregate DER assets.
- ◆ *Smart*DER* agent technology provides an open and extensible architecture that can be readily adapted to this changing marketplace.
- ◆ The next step is to integrate this technology with others already in the marketplace and test *Smart*DER* technology in a real-world environment.