

# 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](http://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:

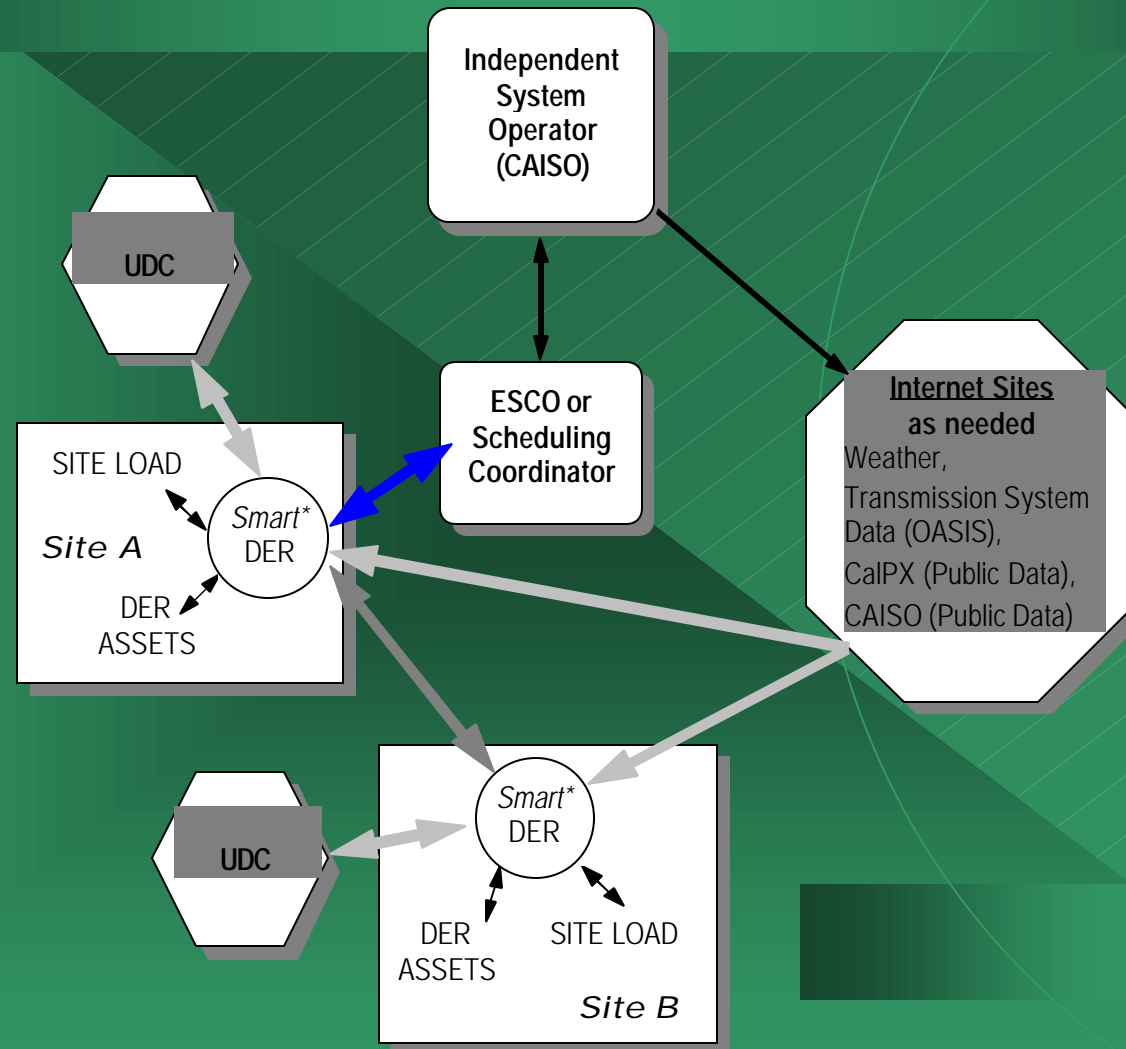
- Multi-agent systems (a.k.a. Agency) allow distributed processing
- Agent complexity is kept low while agency intelligence is high
- Agent-based solutions are more open and extensible

# Why Use Intelligent Software Agents?

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

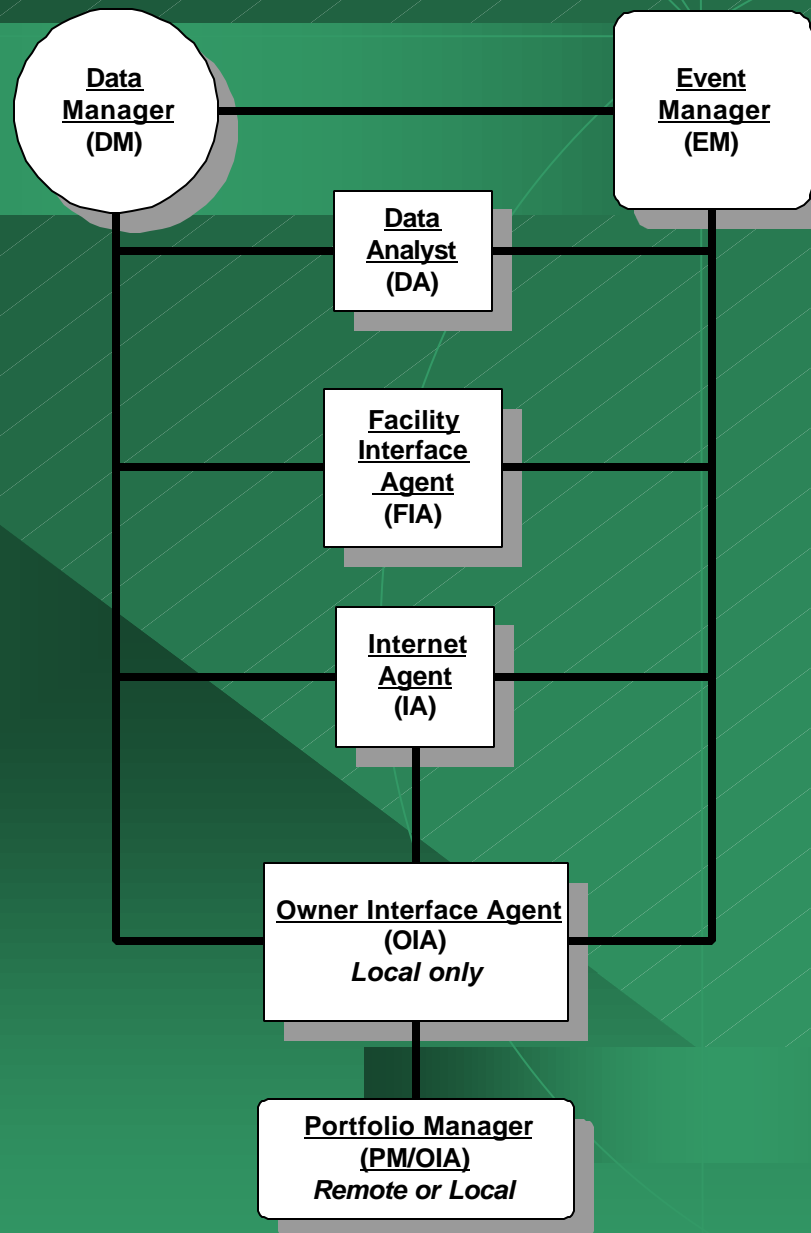
- An open / extensible solution is needed
- DER benefits are application & location specific requiring local knowledge and decision-making
- Information comes from a variety of disparate sources
- Aggregation of loads/supplies requires communication / collaboration between sites
- A dynamic decision-making 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**

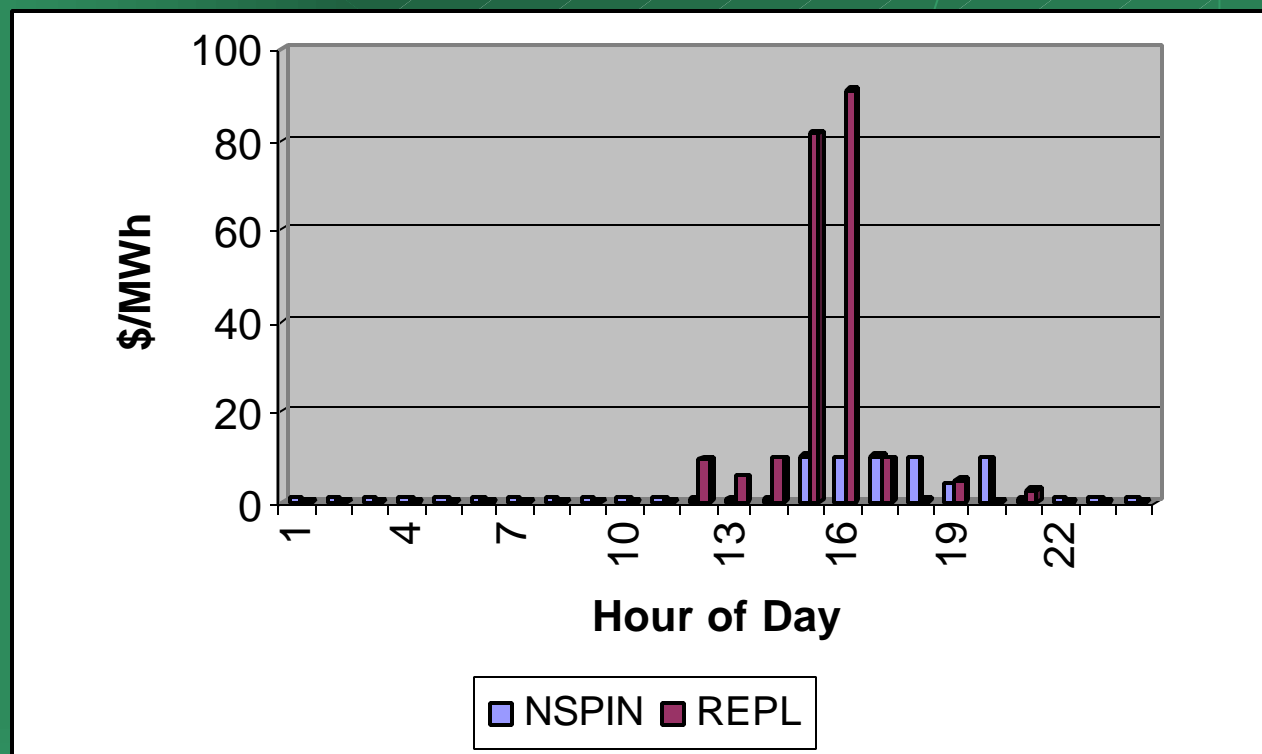
  - No operation*

  - Operate to displace site load*

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

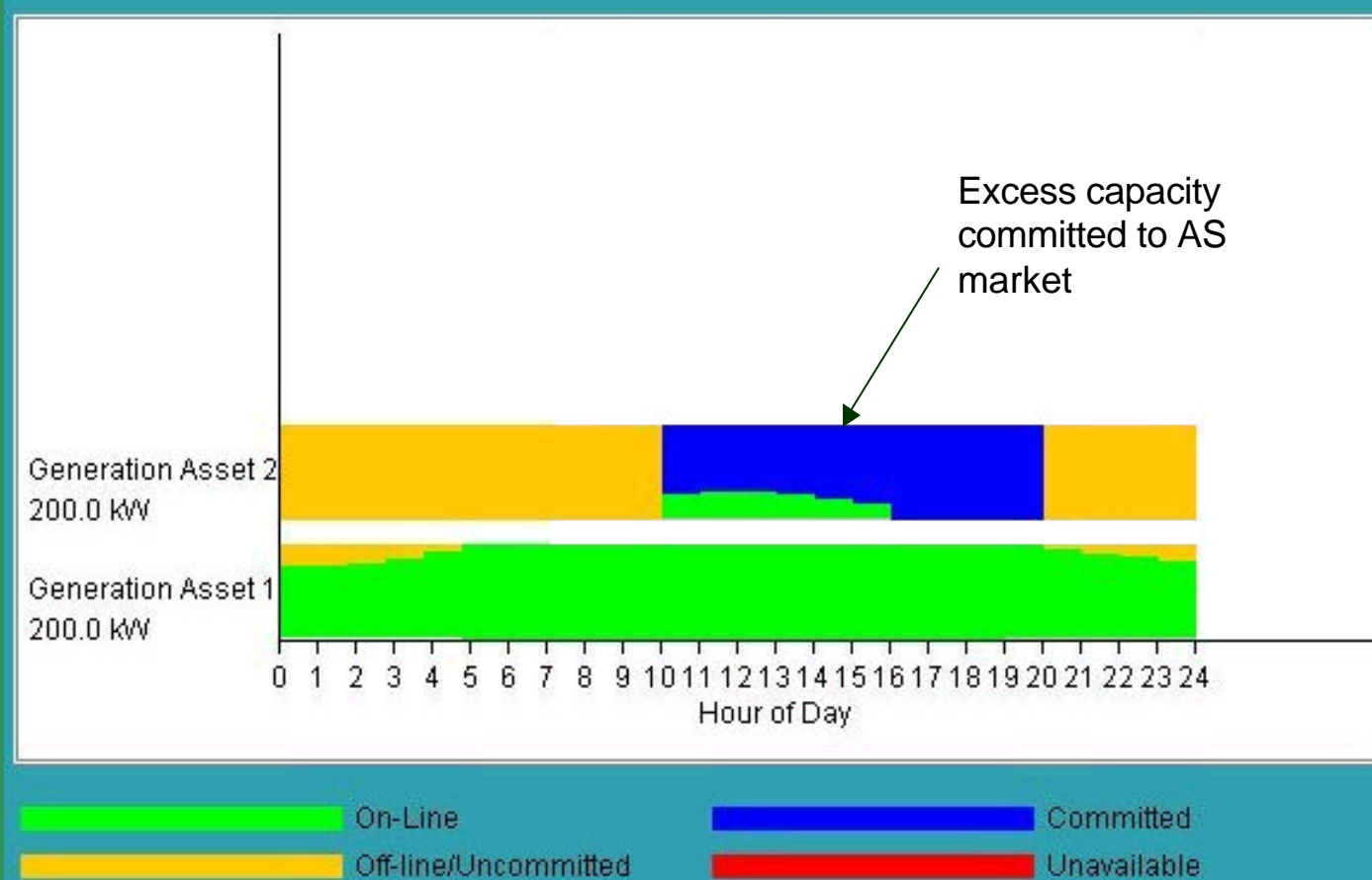
# Demonstration Day Pricing - 9/28/99

## Ancillary Services Pricing



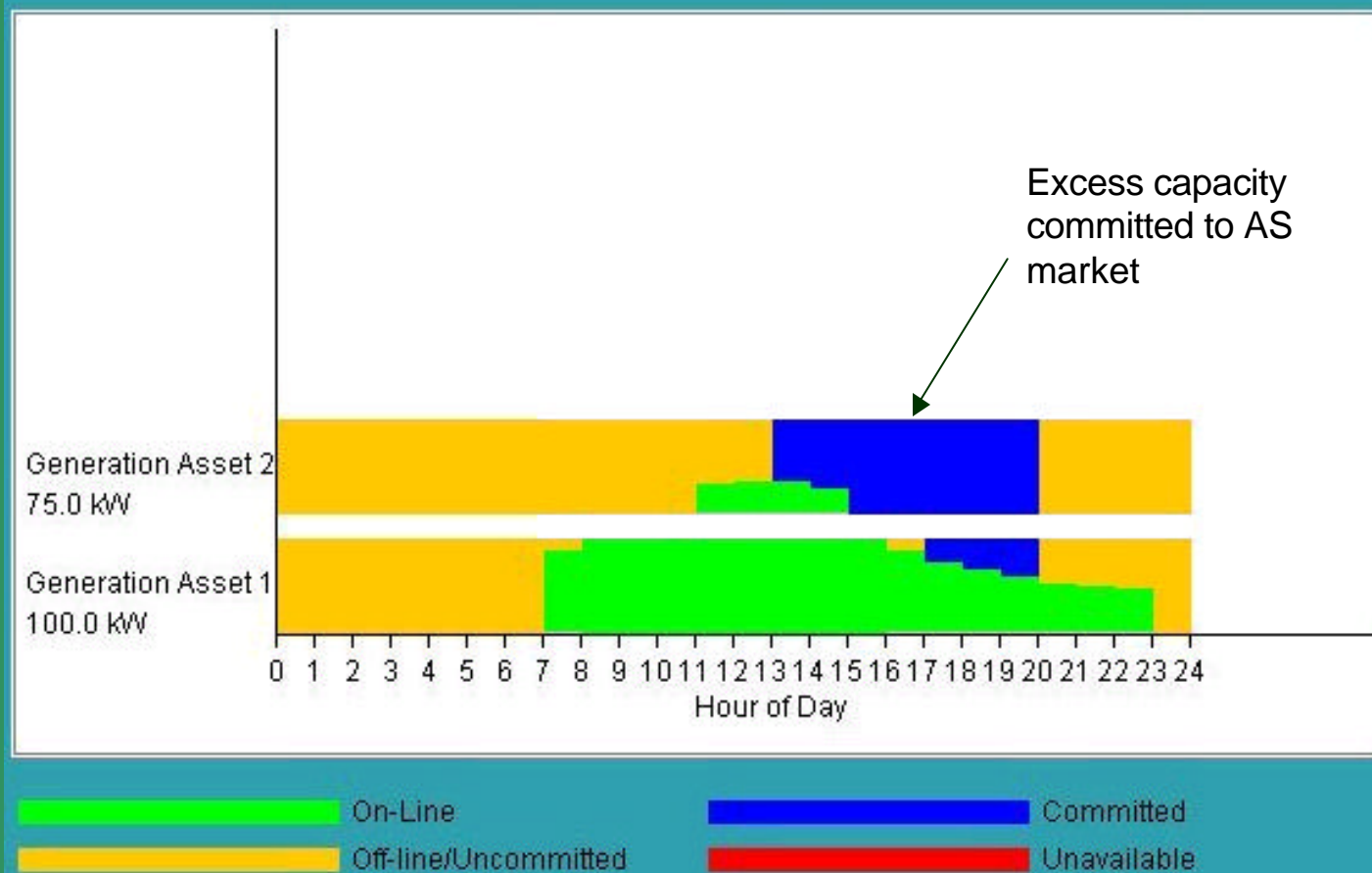
# Asset Status/Schedule - 9/28/99

## 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.