Vision of a Demand Responsive Future

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DRRC Program Outreach Manager
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Demand Response in Year 2015

Disney’s First Law
“Wishing makes it so.”
Definitions

**System Integration**
The deployment of multiple systems, networks or other assets that are linked together to accomplish a common objective.

**System Interface**
The point where data or information is exchanged to link one system or asset to another - an interface defines methods.
Three Customer Examples

- **Residential Minimum Functionality**
  - Elderly, low technology tolerance
  - Low user, small house
  - Medical condition warrants exemption

- **Residential Optional Functionality**
  - Middle age, high technology preference
  - High user, large home, many loads
  - Sophisticated capabilities

- **Large Commercial**
  - Large commercial / retail office space
  - National ownership and control
  - Sophisticated capabilities
Customer Example - 1

- Residential Minimum Functionality
  - Elderly, low technology tolerance
  - Low user, small house
  - Medical condition warrants exemption

SETUP - Operation

- Ready to go out of the box
- Vertically integrated one-way PCT
- Operational status indicators
- Pre-programmed Lifestyle, Comfort, and Reliability settings
- Pre-programmed for CPP response
- Permanent or on-demand override
- Utility Setup Checklist – RFID or other exemption process.
- PCT Manufacturer warranty

Lifestyle Settings
- Weekday Workday 8:00am-5:00pm
- Weekday Evening 6:00pm-10:00pm
- Weekday Morning 6:00am-8:00am
- Weekday Night 10:00pm-6:00am
- Weekend Day 7:00am-9:00pm
- Vacation Away

Comfort Settings
- Cooler
- Warmer

Economy Settings
- Standard (default)
- Moderate
- Super Saver
Example Customer #1: Mrs. Meg A. Watts

- 78 years old, widowed for three years
- Fixed income, needs to live within a budget
- Not familiar with technology
- Just moved into a retirement condo
- Recent health problems
- Requires 24-hour monitoring equipment
Example: Mrs. Meg A. Watts
Her son helps her move in...

- **Mr. Less Watts calls the utility in advance**
  - They ask a few brief questions
  - Lifestyle, home features, exemptions
  - They mail Less an information packet and checklist

- **Shows her the thermostat**
  - Yellow light – shows it is active and receiving test signals
  - Blue light – flashing means CPP is coming, solid means CPP is here
  - Red light – flashing means Stage 1 emergency, solid is Stage 2
  - Override button – disable pre-programming for CPP or Stage 1
  - “Warmer” and “Cooler” arrows
Example: Mrs. Meg A. Watts
Setup is Simple…

- Pre-programmed by retirement community
  - Lifestyle: home all week
  - Comfort: warmer
  - Economy: moderate

- Ready to go out of the box
  - Can use the defaults, or program her own settings
  - Can override the programmed settings at any time

- Meg chooses to use the defaults

- She is eligible for an exemption due to her medical condition
  - Less holds the RFID tag on the checklist near the thermostat, presses button
  - Thermostat acknowledges that Stage 2 response is disabled

- Yellow light is on to show all is well
Example: Mrs. Meg A. Watts
A Critical Peak Occurs

- **Meg finds out that morning**
  - Her morning newspaper had a banner on the front page
  - TV news had an icon in the corner of the screen
  - She checks – yes, the blue thermostat light is flashing

- **At 2:30 pm, the thermostat beeps**
  - Blue light is now solid
  - Temperature set-point has been increased to 76 degrees
  - Meg reminds herself to check later that it goes back down
Example: Mrs. Meg A. Watts
Later that day, an emergency...

- Meg is entertaining friends
- 4:00 pm: Another beep from the thermostat
  - Meg checks – blue light still lit, red flashing: Stage 1 alert
  - Temperature now set at 77 degrees
  - One friend says she uses the “super saver” setting, she just goes to the clubhouse when red flashes

- A few minutes later, it beeps again
  - Meg’s setting stays at 77, but the numbers flash
  - She gets an medical exception, or her cooling would be disabled
  - Her friends decide to stay for a while – it will be better

- At 6:35, the lights go off and the setting returns to 75
  - Her friends leave a little later
Example: Mrs. Meg A. Watts
What Meg didn’t see…

* The Critical Peak:
  - ISO issued the CPP when wholesale price exceeded a threshold
  - Utility sent CPP signals to 1.5 million houses
  - Real-time monitoring created a closed-loop response
  - Start times were randomized to balance the impact of removing and returning load

* The Emergency:
  - The Statewide Power Management System (SPMS) registered a forced outage on a major supply point
  - ISO sent signals directly to customers, bypassing utility
  - When first stage wasn’t sufficient, sent out another round
  - Instantly received an additional 2GW of load relief
Customer Example - 2

Residential Optional Functionality

- Middle age, high technology preference
- High user, large home, many loads
- Sophisticated capabilities

Performance Standard

SETUP - Operation

- Customized to customer facility
- PCT functionality integrated into appliance controls
- Two-way, private service and signal provider
- Full home automation links
- Dynamic pre-cooling or standard setback based on notice available
- Communication interlocks with other appliances / loads

- End-use monitoring through utility or private service
- Near real-time bill monitoring
- Home monitoring and maintenance contracts
- Operation / displays through handheld remotes, computer or TV monitors
Customer Example - 3

- Large commercial / retail office space
- National ownership and control
- Sophisticated capabilities

**SETUP - Operation**

- Internet link to price server
- Price and reliability strategies programmed into EMS, customized to building systems and tenants
- Strategies integrate shifting, scheduling and backup/distributed generation.
## System Integration

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<td>• Price Signaling</td>
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<td>• Outage management</td>
<td>• Communication Test</td>
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<tr>
<td>Statewide Reliability Exchange (Signaling)</td>
<td>• Price Signaling</td>
<td>• PCT dispatch</td>
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<td>Statewide Power Management (SCADA)</td>
<td>• Monitor Distribution</td>
<td>• Monitor T&amp;D</td>
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<td>• Monitor PCT calibration</td>
<td>• Resource dispatch</td>
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CALIFORNIA ENERGY COMMISSION
Advanced Metering Infrastructure (AMI)

Functions
Collect billing and outage management metrics.

Local Area Networks

Wide Area Networks

Utility #1

- Internet
- Wireless
- Phone

Gateway

CIS
Billing
AMI Maint.
Hourly Price
Statewide Power Management System (SPMS)

Functions (SCADA)
- Monitor and control distribution system performance.
- Create Price Response / PCT database

Functions (SCADA)
Monitor and control transmission system performance and linkages to utility distribution.
Statewide Reliability Exchange

Hourly Price → Utility #1

CPP – Reliability Advisory

Service Area Broadcast

Certified Signal Provider

Wireless
PLC
Wired

News Services
Subscriber Alert Services

ISO

Pricing and Reliability Models

• Critical Peak Price
• Real-time price
• Reliability status
• Reliability control

Function
• Broadcast Price / Test signals
• Broadcast Reliability signals
Calibrate CPP Response

Statewide Reliability Exchange

Statewide Power Management System

Calibration Test Signal

Price Response Isograms

Load Available (kW)

Time-of-Day
TEMPERATURE 100 degrees
Feeder #12345-2

Function
Calibrate automated price and reliability response.
System Emergency
Initiating a CPP Response

Statewide Power Management (SCADA)

- Automated diagnostics
- Control tailored to need
- Closed loop management

Utility #1

System Status

ISO

Statewide Power Management (SCADA)

- Critical Peak Prices
- Reliability Signals
## Regulatory Policy Assumptions

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<th>Policies and Standards</th>
<th>Purpose</th>
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<td><strong>1</strong> Statewide implementation of advanced metering.</td>
<td>- Facilitate pricing.</td>
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<td>- Support customer education.</td>
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<td><strong>2</strong> Critical Peak Pricing as the default tariff.</td>
<td>- Integrates efficiency and demand response on a common financial basis.</td>
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<td>- Demand response becomes a condition of service for all customers.</td>
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<td><strong>3</strong> Programmable controllable thermostats in the Building and Appliance Standards.</td>
<td>- Enable / automate customer choice.</td>
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<td>- Economic response (CPP day ahead)</td>
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<td>- Reliability response (CPP day of)</td>
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<td>- Enable system protection and redefine outage management.</td>
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CPP Rate Features

- **Participation**: Single default CPP tariff mandated by CPUC for all residential and commercial/industrial customers.
  - Customers < 20 kW - option to risk-adjusted level billing.
  - Customers > 20 kW - option to real-time price (RTP)

- **Rate Structure**: Two part time-of-use (peak / off-peak) with a dispatchable critical peak price.

- **Revenue Requirement**: Split into base and critical peak.

- **Notification**: Advance notice and instantaneous dispatchable critical peak price.

- **Application**: Applicable year-round, based on need.

- **Low Use Customers**: Automatic 130% baseline capped rate or CPP, whichever is lower.

- **Dispatch Criteria**: Pre-established price and reliability thresholds (no artificial caps).
PCT Legal Features

- **Standards**: Specified as both a design and performance standard.
- **Functional Requirements**: Included in the Building and Appliance Standards as a requirement for all residential and commercial/industrial facilities.
- **Availability**: Commercially available both as a vertically integrated replacement product and sensor and control functions embedded in appliance and/or HVAC control logic.
- **Ownership**: Customer owned.
- **Warranty**: Manufacturers and vendors required to provide standard five-year parts, material, communication systems and workmanship warranty.
PCT Operational Features

- **Communication**: Mandated one-way, to a Statewide standard signal or a signal provided by certified signal provider.
- **Status Indicators**: (1) operations (2) Price, (3) Emergency
- **Control Strategies**: Pre-programmed, randomized, designed to balance load through pricing / control period.
- **Lifestyle settings** – on/off operating schedules
- **Comfort settings** – temperatures by time period
- **Economy / Bill Management Settings** – Standard, Moderate, Super Saver CPP and Stage 1 emergency response
- **Override**: Applicable only to CPP and Stage 1 response. Stage 2 response is non-overrideable. Exemption capability.
- **Expansion / Programmability options**
Utility Responsibilities

- Demand response programs replaced with CPP default rate.
- Provide customer education services
- Provide customer / facility information services
- Provide technology / service provider resource services
- Price, reliability and related customer service signaling and messaging services.
CPUC Responsibilities

- Adopt business plans to implement advanced metering systemwide.
- Adopt Critical Peak Pricing (CPP) as the default tariff.
- Modify utility outage management plans to allow end-use PCT-based partial outages.
- Eliminate promotion of demand response programs with participation incentives and promote customer response/customer ownership under CPP.
- Redefine utility role as educator and facilitator.