Vision of a Demand Responsive Future

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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

Design Standard

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
- Vacation Away

Comfort Settings

- Cooler
- Warmer

Economy Settings

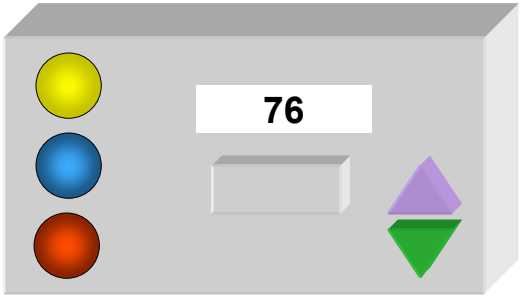
- Standard (default)
- Moderate
- Super Saver

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…

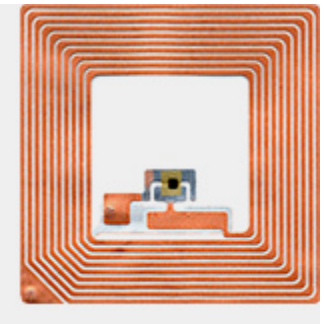


- **Mr. Less Watts calls the utility in advance**
  - They ask a few brief questions
  - Lifestyle, home features, exemptions
  - They mail Less an information packet and checklist
- **Shows her the thermostat**
  - Yellow light – shows it is active and receiving test signals
  - Blue light – flashing 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

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

AutoDR

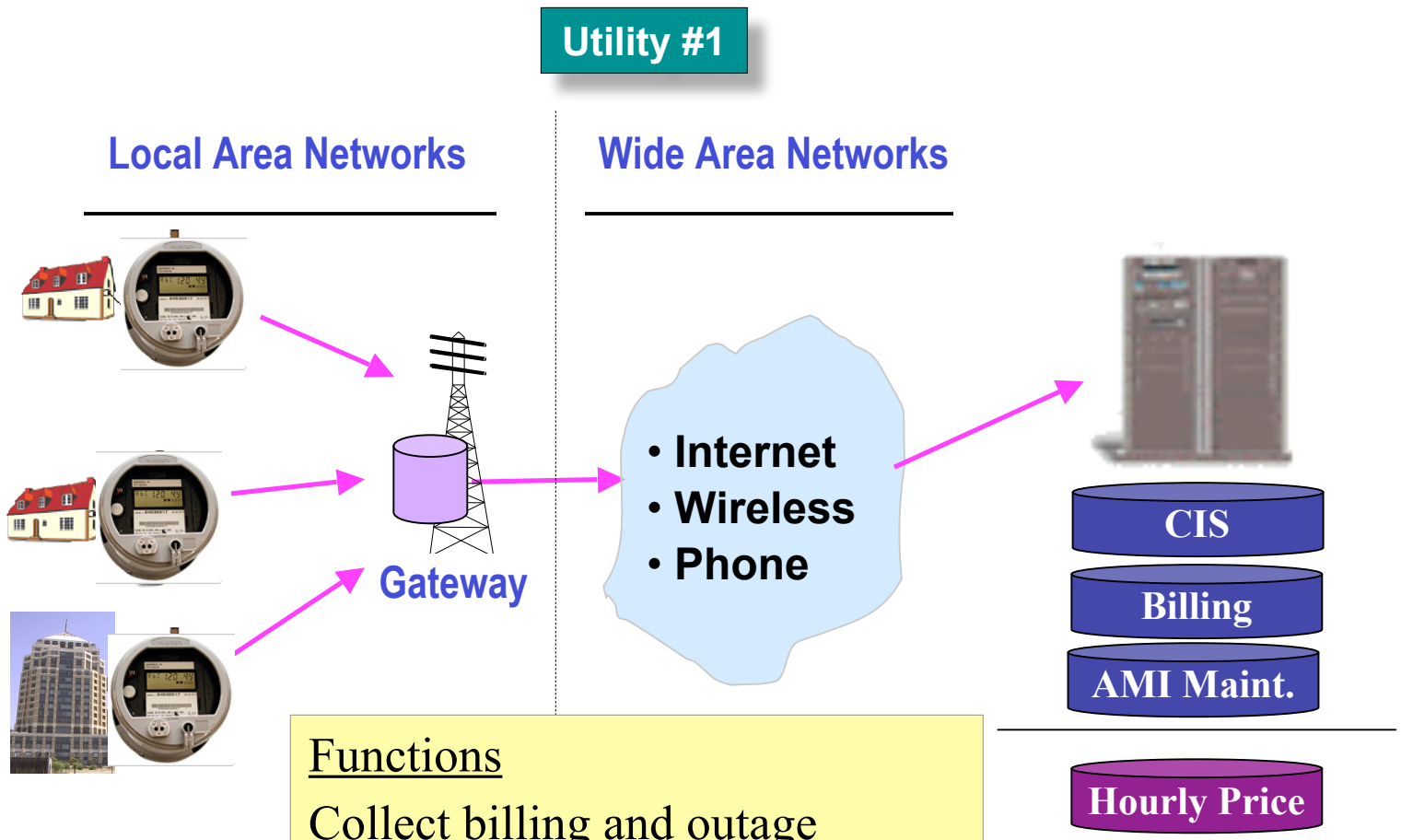
SETUP - Operation

- 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

System	Utility #1	ISO
Advanced Metering	• Collect billing metrics • Outage management	
Statewide Reliability Exchange (Signaling)	• Price Signaling • Commmunication Test • PCT calibrate	• Price Signalin • PCT dispatch
Statewide Power Management (SCADA)	• Monitor Distribution • Monitor PCT calibration • PCT calibration	• Monitor T&D • Resource dispatch

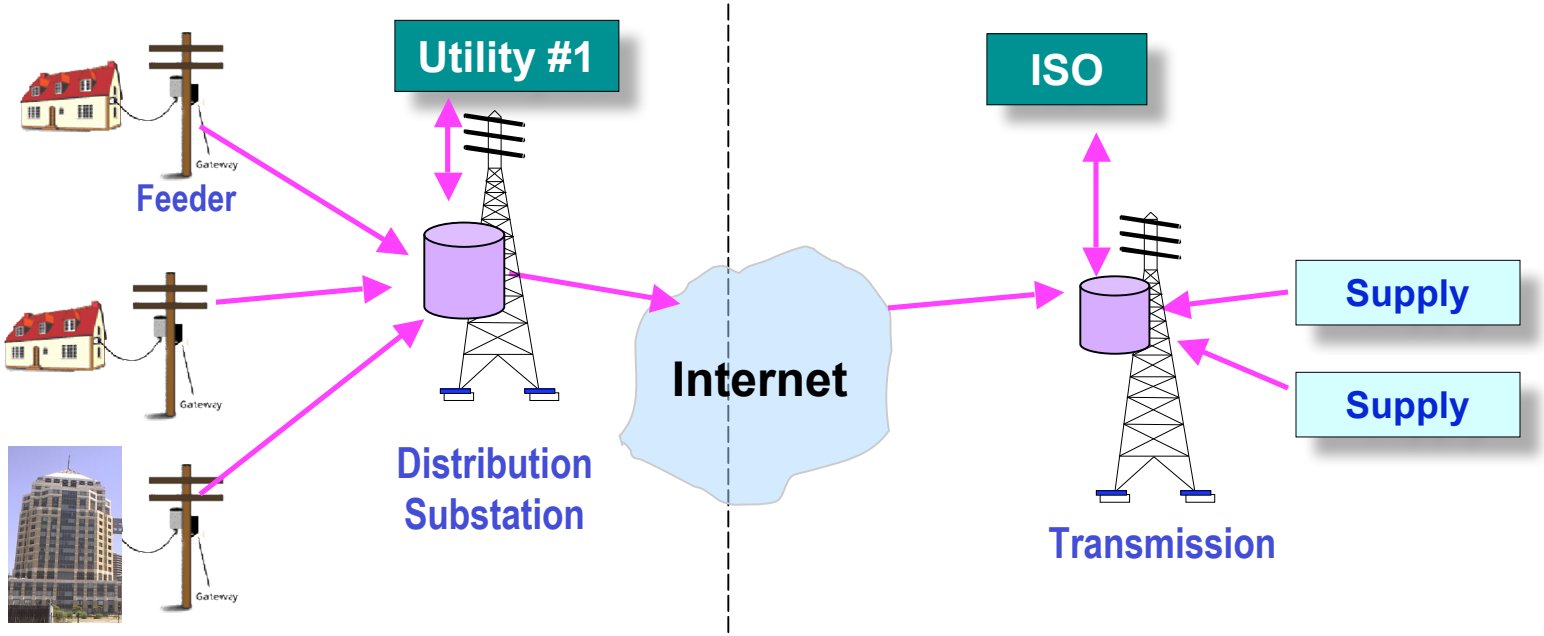
Advanced Metering Infrastructure (AMI)



Functions

Collect billing and outage management metrics.

Statewide Power Management System (SPMS)



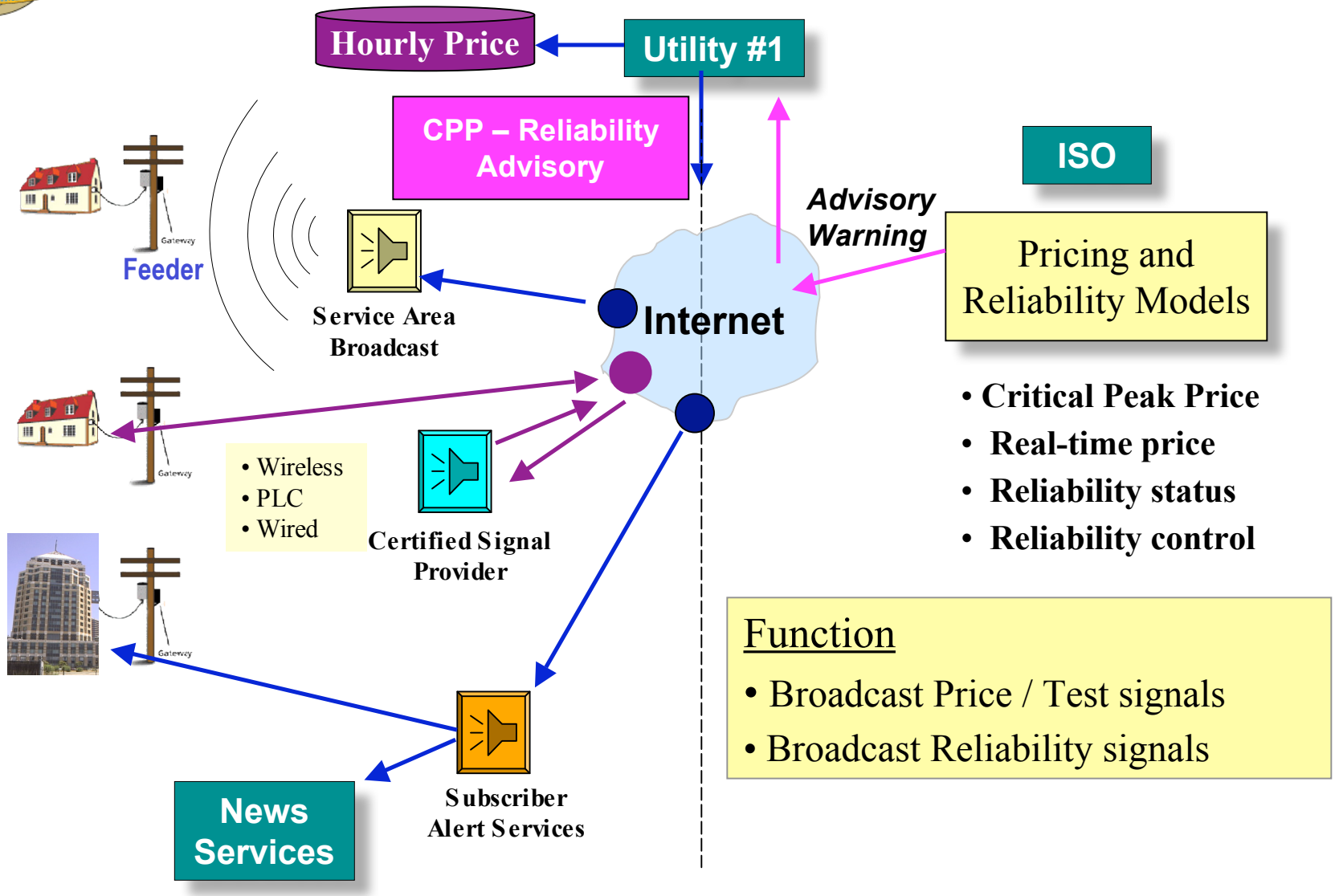
Functions (SCADA)

- Monitor and control distribution system performance.
- Create Price Response / PCT database

Functions (SCADA)

Monitor and control transmission system performance and linkages to utility distribution.

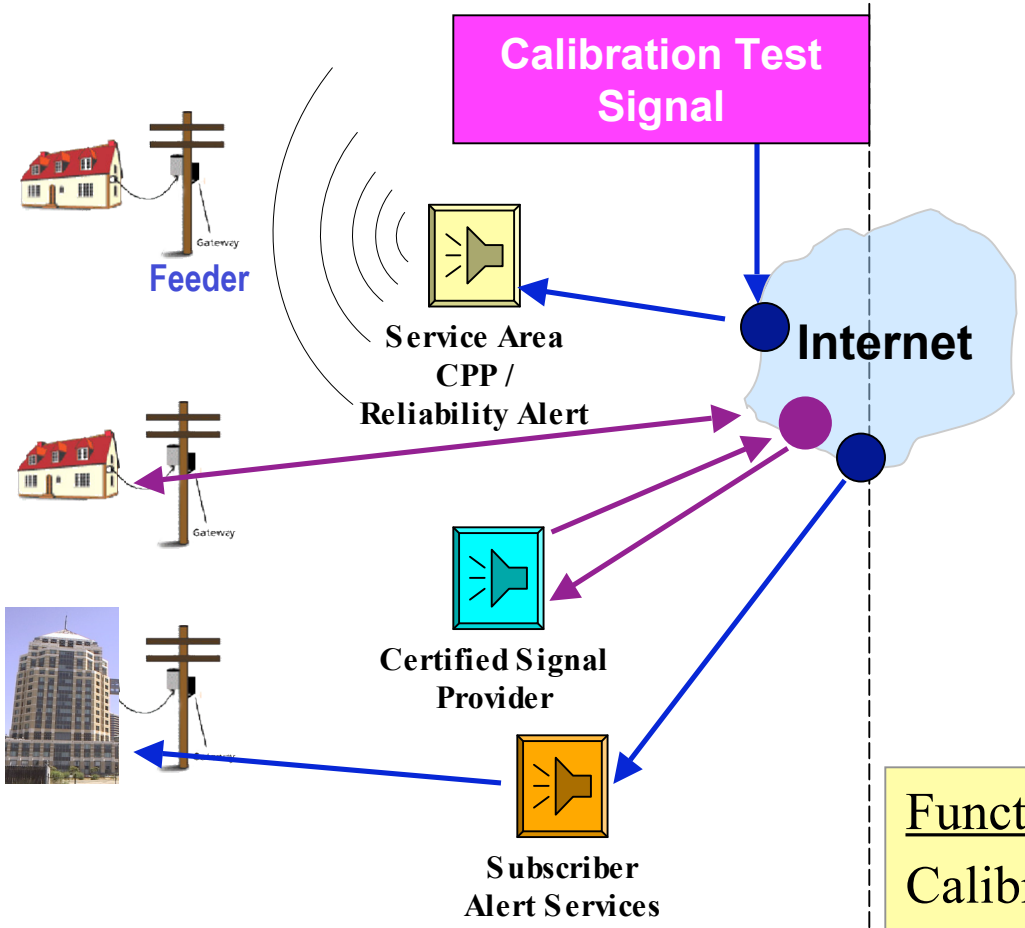
Statewide Reliability Exchange



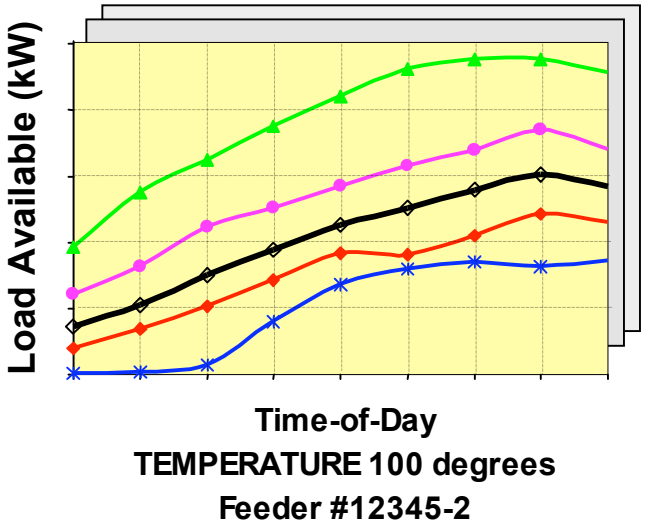
Calibrate CPP Response

Statewide Reliability Exchange

Statewide Power Management System



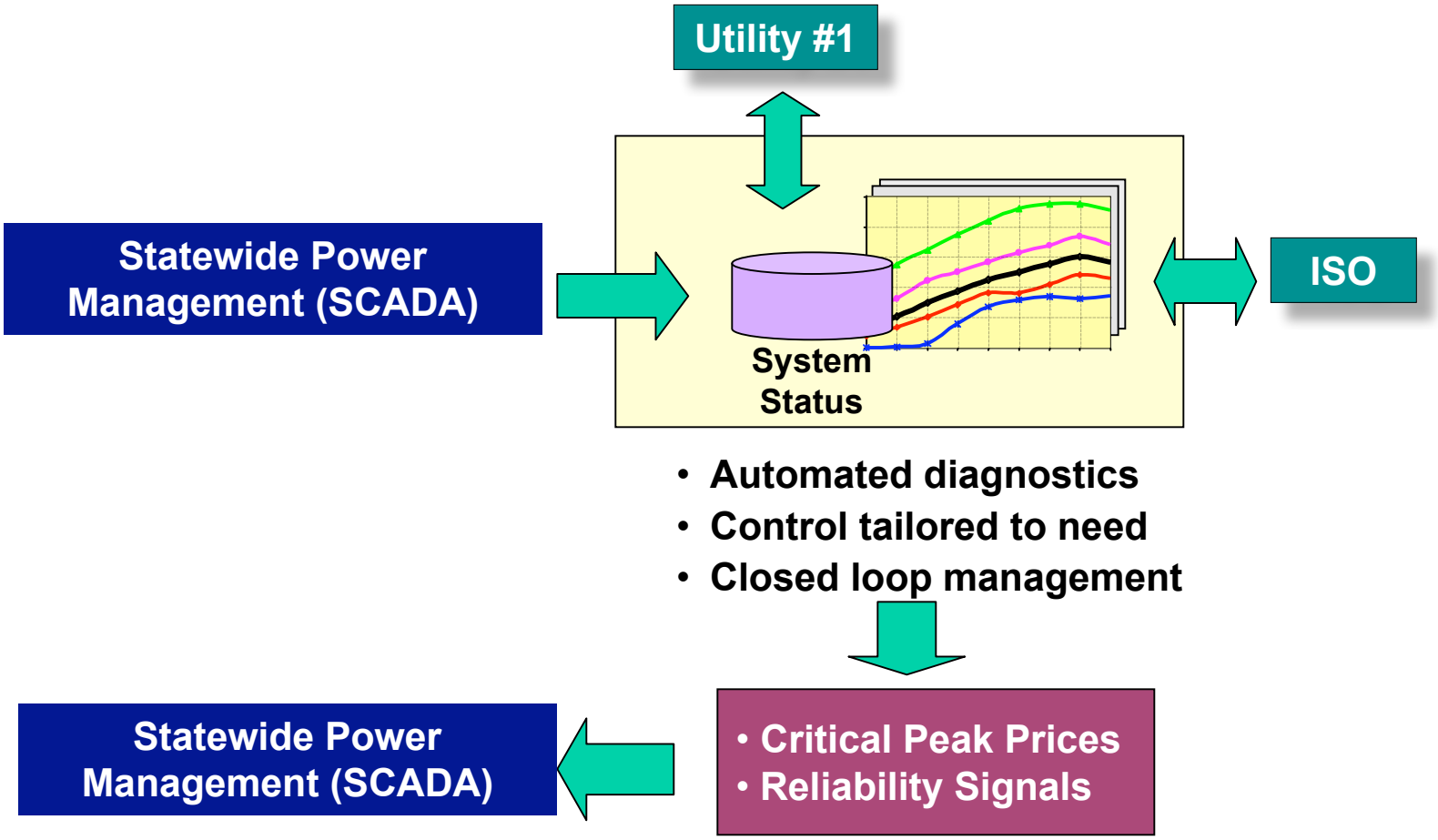
Price Response Isograms



<u>Function</u>

Calibrate automated price and reliability response.

System Emergency Initiating a CPP Response



Regulatory Policy Assumptions

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

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.