Appendix

Potential Demand Response Loads

For commercial facilities, there are specific areas you can find reducible loads.

- **Fans in HVAC systems.** HVAC fans can be cycled in sequence so that no fan is off or operating at reduced speed for more than a brief period (say, from 10 to 15 minutes). Using this strategy, no one area is greatly affected due to building thermal inertia. Using variable speed drives with HVAC fans is very beneficial—a 20% reduction in speed may produce nearly a 50% decrease in power demand.
- **Increasing space temperatures.** This strategy does not require shutting off the cooling to the entire building. Instead, an option might be to raise the temperature from two to four degrees in sequenced zones of the building for periods of 10 to 15 minutes, again taking advantage of building thermal inertia.
- **Reduce outside air intake.** For short periods of time, reducing or cutting off completely outside air flow can help reduce cooling demand. Outside air flow is typically based on a conservative estimate of building occupancy levels, which is usually higher than the actual amount. Brief reductions for a few hours on a few hot summer days can reduce cooling demand, since both latent and sensible loads are reduced when moist, hot outside air is restricted from entering the building.
- **Cycle air conditioning units.** By cycling window, packaged, or split air conditioning units, summer peak demand can be greatly reduced. Cycling these typically inefficient systems in groups, so that each group is off for 10 to 15 minutes at a time, will cause only brief discomfort for occupants and will not harm the compressors.
- **In hybrid plants, switch to non-electric units.** For air conditioning plants that include both electric and non-electric chillers, the output of the non-electric unit should be increased to a maximum level, and the electric unit's output lowered. Even if the average price for cooling is lower with the electric unit, the incremental cost of power during demand response will actually make running the non-electric chiller more cost effective.
- **Use on-site backup generators.** Some buildings are only able to use backup or emergency generators during a blackout. However, if they are set up to supply dedicated loads that can be briefly interrupted during a switchover from utility power (such as HVAC fans), running these generators during a demand response can be quite profitable. Be aware that there are some important qualifiers: EMS/BMS programming is required to automatically transfer generator output back to emergency loads during an actual blackout; automatic transfer systems acceptable to the utility may be needed to avoid accidentally feeding into the power grid; emissions permits also may need to be amended to allow this type of operation.
- **Hallway lighting.** Some dimmable or multi-level electronic ballasts may be activated by power-line carrier (PLC) signals to reduce lighting levels. In some cases, fixtures may already be wired so that a portion of the fixtures (say, one third) are on an emergency circuit that could be used to power only the reduced portion during a demand response request. If this strategy is properly designed so that there is sufficient lighting during an emergency evacuation, there should be no problem with using the hallways during the demand response period.

- **Stairwell lighting.** In buildings with elevators, many stairwells are overlit. This means a portion of these fixtures can easily be temporarily shut off or dimmed. This approach should make sure that there are no locations that are too dark and become hazardous. The EMS/BMS system can restore stairwells to full lighting in case there is an emergency evacuation during the demand response period.
- **Outdoor lighting, signage, window display lighting.** These loads are typically small, but do add up, particularly when there are incandescent lamps involved. For facilities with tenants or sales departments using display lighting, agreements need to be made before reducing the lighting.
- **Public space lighting and ventilation.** For lobbies, cafeterias, or concourses that receive a significant amount of natural light, much of their electric lighting can be briefly turned off.
- **A portion of elevators.** Many elevator systems are designed to handle traffic during building "rush hours" and really don't need to maintain all of them in standby operation at other times. If modern electronic controls are installed, cycling or shutting down elevator banks will not produce much savings. However, if there are old style motor-generator sets (that consume up to 20% of peak load while idling), cycling or shutting down can produce significant savings.
- **Vending machines.** Vending machines can pull 400 watts or more of power. If the space where the vending machines are installed is air conditioned, then shutting them down for a short period of time will not affect the packaged food inside (unless it is ice cream or prepared foods such as sandwiches).

Specific Target Businesses and Facilities

In this section we explore some specific businesses and facilities in terms of how well they may qualify for participating in demand response programs, and in what specific ways they may be able to reduce energy use.

As a rule, many industrial loads can be shifted to off hours without negatively affecting operations. Also, many commercial and institutional facilities can typically identify a variety of loads that can be interrupted or cycled that will yield an overall demand reduction from 5% to 20%. Also, power costs can be greatly reduced in situations where facilities have energy management systems or building management systems installed, and power-line carrier (PLC) technology may be applied. For buildings or facilities that have tenants and that sign up with a demand response program, it is important to keep the channels of communication open. Coordination with tenants and occupants is essential to provide advance notice that a change in services may occur for a few hours and to address any complaints.

Office Buildings

Office buildings offer some small potential for demand response—for example, hallway lighting, and ornamental lighting. Some are difficult candidates because they can't reduce the HVAC load and still keep the occupants comfortable.

In the lighting panels, operators can tag certain circuits to shut off during a request. If they are notified a day ahead, the kitchen can schedule cold foods, which will eliminate the need for electric appliances, exhaust fans, and some lighting.

Other options include:

- Shutting down some vertical transportation.
- Air conditioning: can do load cycling of the package units, and temperature reset on chilled water system. With day-ahead notice, can possibly pre-cool the building to a lower-than-normal setpoint.
- The printing facilities can operated during off-peak hours.

Schools

Schools are usually not good candidates for demand response. However, some may be able to use reset thermostats, or reduce some lighting.

Hotels and Motels

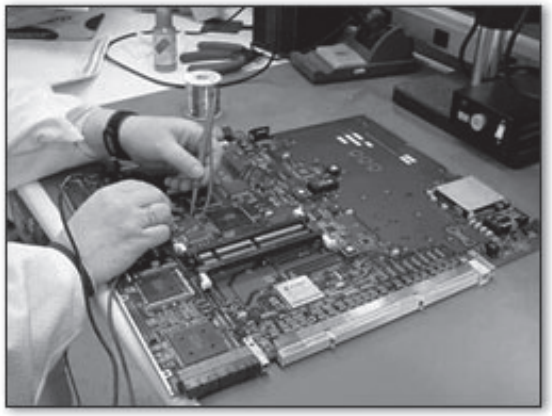
Hotels and motels may be able to reduce load through:

- Ornamental lighting and some signage
- Fountains and swimming pool pumps
- Other lighting (such as hallway lighting, display lighting and more)
- "Vertical transportation" (the "down" escalators, and some elevators)

Retail Industries

Retail industries offer some opportunities for demand response.

- Vertical transportation.
- Ornamental features.
- Marketing lighting displays. This includes lighting that creates an atmosphere for displaying merchandise, for illuminating products to highlight their best features, and lighting to give a positive store image and create a pleasant atmosphere for shopping. Also, recessed lighting and high ceiling and open warehouse lighting present opportunities.
- Some limited air conditioning reduction.



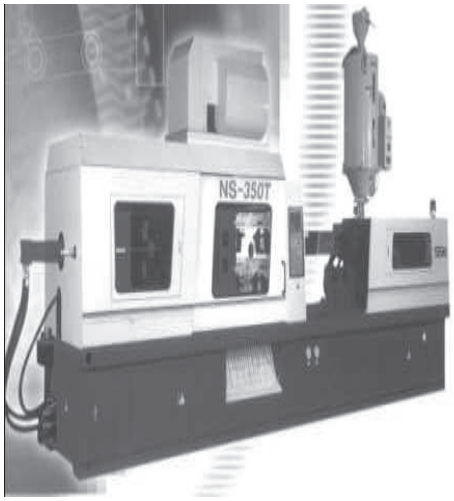
High Tech Manufacturing

High-tech industries present many opportunities for demand response. These businesses can participate with a partial energy use reduction, to a complete shut down of operations.

As a rule, the best opportunities come from operations that are energy intensive with few employees (high- and low-tech).

Some examples in this sector include makers of semiconductor chips and thin-film products like hard disks, floppy disks, and other mass-storage media. These facilities can:

- Reduce lighting.
- Reduce production. (Because reduced production generates less heat, facilities can shut off or cut back on AC—this is often referred to as the "interactive" effect.)
- Secure the air compressor system.



Plastic injection molding machine

Injection Molding

- Complete curtailment of some or all production and perform maintenance on the equipment.
- Secure ancillary AC and cooling equipment to prevent from cycling on.
- Secure the air compressor system.
- Shut off plant lighting

Cold Storage

Some ways cold storage facilities can participate in load curtailment include:

- Shut off or reduce refrigeration load
- If storage exceeds maximum temperature, can aggregate with other cold storage facilities and divide the curtailment period.
- Often frozen products are not affected for up to two to three hours. (for example, it would be OK to reduce the product temperature from 10 degrees to 20 degrees.
- Shut off evaporator fan
- Lighting
- Secure fork lift charging
- With day-ahead notice, pre-cooling may be an option.

Food Processing

Some ways food processing facilities can participate in load curtailment include:

- Shut off or reduce refrigeration load
- If storage exceeds maximum temperature, can aggregate with other cold storage facilities and divide the curtailment period.
- Often frozen products are not affected for up to two to three hours. (for example, it would be OK to reduce the product temperature from 10 degrees to 20 degrees.
- Stop production and all ancillary equipment, including lighting, air compressor, refrigeration equipment if possible.
- Shift production hours to later in the day (especially with day-ahead notice).

Stone and Concrete Products

Facilities that deal in stone and concrete products might be able to totally curtail operations. However, facilities in this category often begin operations early in the morning and finish the day around 2 pm. So, it is possible they may not have any afternoon load to curtail.

Oil Pumping

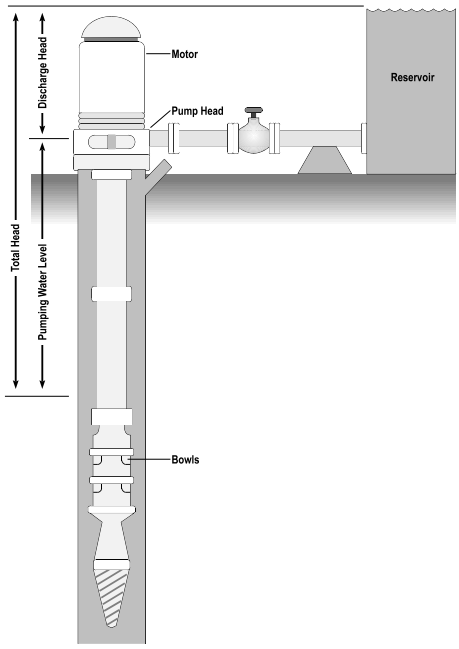
This area could be interesting since they use many electric motors. However, when the price of oil is over $20 per barrel, it makes more sense economically to pump oil.

Lumber Mills

Lumber mills are good candidates for demand response. These operations can curtail all motors, some lighting, air compressors, and fork lifts.

Aluminum Melting and Finishing

Aluminum melting and finishing faculties use electric kilns and other equipment in their processes. These and other industrial loads often can be shifted to other times of the day without interfering with the facility's operations.



Agricultural Water Pumping

Agricultural water pumping presents some possibilities for demand response.

- Adjust irrigation schedules to non-critical hours, particularly night time.
- Operate additional pumps if available after curtailment to make up the required water quantity.
- Note that often night-time irrigation is more difficult because farmers and others cannot see the water flow very well and cannot prime siphon irrigation systems.

Municipal Water Pumping

Municipal water pumping is an excellent consideration for demand response. Municipal utility companies often have no idea of the possibilities for them to participate.

Because electricity rates are passed on to their water customers, they may not have incentive to participate.

There may be significant strategies for pumping water into storage tanks, then use this water when a curtailment is requested rather than pumping water from wells.

In some cases a curtailment program may cost-justify the construction of new storage facilities. Not only could they provide a contingency for demand response, but also a reserve in case the pumps fail.

Some municipal water pumping agencies have permits to operate internal combustion engines, that can be used for the duration of a curtailment.

Communication and Telemetry Methods and Options

Communications for controlling load are either made very quickly, say within minutes or else more slowly, say within days.

- Rapid communications are made to energize or de-energize the load; shut down or reduce the load; adjust thermostats or HVAC system operation. Often enhanced automation strategies such as BAS and EMS are involved.
- Slower communications are made to measure the response of the load or the load profile.

In some cases the rapid communications involve use of the internet, which is a low-cost alternative. Using the internet and local control of the load provide the customer with the ability to interrupt as necessary depending on market conditions.

Load profile is usually provided by an interval demand meter.

Communications and control options include:

- Telephone.
- Cellular phone.
- Radio communications.
- Combinations of communication systems that use packaged software (such as Windows-based telecommunications systems that provide real-time data and remote control).
- Internet based market programs (day ahead curtailment prices are posted and participants decide whether they want to curtail load; participation is voluntary).
- Internet based communication, control and metering services (turnkey services offered to businesses; data collected and transmitted by telephone, the Internet, radio, etc. to utility companies).

Audit Form

1. Collect the information identified in the table below:

Date of the audit	
Audit performed by	
Facility Name	
Facility address and city	
Chief engineer name	
Telephone number	
Name of local utility	

2. Collect the following information:

Number of meters & I.D. #s	
Utility rate schedule(s)	
Site's Peak kW Demand	
Emergency Generator(s) kW	
Can the E.G. operate while the utility is simultaneously providing electric power?	
If E.G. is "on", how many elevators will be operable?	
Size of the fuel tank (hrs)	
Facility's AC area (Sq. Ft.)	
Facility's number of floors	
Take photos of the facility	
Get a site plan of the facility	

3. Generally speaking, identify what loads they are willing to curtail.

Some perimeter lights (Y/N)	
Some interior lights (Y/N)	
Lights in main lobby	
Lights in display areas	
Lights in loading docks	
Lights in storage rooms	
Other lights	
Cycle or turn off supply fans	
Turn off some exhaust fans	
Turn off escalator motors	
Turn off one or two elevators	
Reset room thermostats (78°)	
Reset CHW supply temperature	
Production lines (electric ovens, motors, conveyers, etc.)	
Lights in the production lines	
Other	

Once we learn the general loads or areas they are willing to curtail, it is time to start identifying the project specifics.

4. **Review the electrical and mechanical drawings to identify the following information.**

Number of lighting panels in the facility	
Number of lighting panels per floor	
Number of Air Handling Units in the facility	
Number of Air Handling Units per floor	
Number of motor control centers	
Number of elevators	
Number of Escalators	
Number of production lines	
Other	

The auditor needs to keep in mind that operating staff will be the ones that will affect the load curtailment and they need to be part of the decision making process.

5. Identify the following:

Location of the future communication system PC	
Direct telephone line	
Facility's EMS (Y/N), describe its capabilities and the equipment it controls	
Load curtailment contact	
Target date for the communication system installation and software setup	
Target date for load curtailment certification	

Potential Demand Response Loads

Field Audit

With the facility information on hand, is time to start the process of identifying and testing the load curtailment activities the operating staff will carry out during load shedding periods.

Lighting Panels

Lighting Panel Identification: _____

Panel Location: _____

Voltage: _____

Total Number of Circuits: _____

Number of Circuits in Used: _____

Test Performed by: _____

Date: _____

Circuit Number	Area Served	Leveled Amps	Load Curtailment Test	Actual Amps

Only list those circuits that are selected for load curtailment.

Potential Demand Response Loads

This form should be filled out for every lighting panel in the facility.

Motor Control Center

Motor Control Center Identification: _____

Motor Control Center Location: _____

Voltage: _____

Total Number of Starters _____

Number in Used: _____

Starter Number	Equipment Served	HP	Load Curtailment Test kW Reduction	Maximum Cycle Time

Only list those starters that are selected for load curtailment. This form should be filled out for every motor control center in the facility. (Use attached data collection forms.)

Selected California Demand Response Programs

There are statewide demand response programs, and other specific Utility Distribution Company programs offered by the major Investor Owned Utilities. This appendix provides brief descriptions of the following programs.

- Air Conditioner Cycling Program—Base (ACCP)
- Air Conditioner Cycling Program—Enhanced (ACCP)
- Program Description
- Program Description
- Base Interruptible Program
- California Power Authority (CPA) Demand Reserves Program
- Critical Peak Pricing
- Demand Bidding Program
- Large Power Interruptible (Interruptible Service Program)
- The Scheduled Load Reduction Program (SLRP)
- SCE Energy$mart Thermostat^{SM} Program

As examples, this section describes a variety of demand response programs offered by Southern California Edison that are designed to help customers who qualify reduce energy use during peak times. Participating customers who can reduce power use when statewide energy supplies are low earn financial incentives or other benefits.

Information presented here is adapted from content located at Southern California Edison's Web site:
http://www.sce.com/

(Note: programs may change and will vary by utility. Check with your local utility for current demand response programs that may be available to you.)

Air Conditioner Cycling Program—Base (ACCP)

The Air Conditioner Cycling (Base) program is targeted to residential and customers who will agree to have their air conditioners cycled intermittently when necessary to control peak demand. In return, customers receive a credit on their electric bills. There are two versions of this program—one for residential and one for nonresidential customers.

This program is now open to all residential customers, and residential customers may choose 50 percent, 67 percent or 100 percent cycling strategy levels. Customers who participate in 100 percent cycling receive a credit on their bill of 18 cents per ton of air conditioning per day. At the 67 percent level, customers receive a credit of 10 cents per ton per day. At the 50 percent level, customers receive a credit of 5 cents per ton per day.

Nonresidential customers who choose to participate at the 100 percent level receive a credit on their bills of 20 cents per ton of air conditioning per day. At the 50 percent level, customers receive 7 cents per ton per day. At 40 percent, they receive 4.2 cents per ton per day, and at 30 percent, 1.4 cents per ton per day. The existing program is open to new customers at all cycling levels.

Air Conditioner Cycling Program—Enhanced (ACCP)

Residential and Nonresidential Air Conditioner Cycling programs (Enhanced)
The Enhanced program differs from the Base program in that:

1. The credit is doubled
2. The number of cycling periods is unlimited during the summer season
3. The duration of the cycling period is limited to no more than six hours per day.

Customers who participate in 100 percent cycling receive a credit on their bill of 36 cents per ton of air conditioning per day. At the 67 percent level, customers receive a credit of 20 cents per ton per day. At the 50 percent level, customers receive a credit of 10 cents per ton per day.

Base Interruptible Program

The Base Interruptible Program offers a monthly credit to businesses that commit to reducing power to a minimum pre-determined level when requested. This interruptible rate is designed for customers with at least 500 kW demand who can reduce their electricity usage by 15% of load, with a minimum of 100 kW for each event. In exchange, customers receive a monthly rate credit based on the difference between the maximum demand and the customer's selected Firm Service Level. The I-6-BIP is available to customers who are eligible for service under rate schedule TOU-8 and to existing customers on rate schedule I-6 who complete their annual obligations on those programs.

California Power Authority (CPA) Demand Reserves Program

This program encourages businesses to agree to reduce power usage when supplies are low due to weather extremes, power plant outages, or transmission system bottlenecks. Advanced metering and Internet communications technologies allow businesses to provide power to California just as power plants do, and without any pollutants. Businesses are compensated for choosing to reduce their power usage when it is most needed.

Critical Peak Pricing

The Critical Peak Pricing (CPP) rate offers lower rates to customers who agree to reduce electricity use during critical peak periods during the summer season only. This option is designed for customers with registered demands greater than 200 kW and who can reduce their power use during summer-season peak demand hours—noon to 6 p.m.—during a CPP event. SCE will declare CPP

events a day ahead, and announce them to participating customers when either overall demand for power or the wholesale electricity price is approaching extreme levels. For CPP customers, energy prices during CPP events are three to five times higher than summer energy rates at other times, but prices at other times are lower than comparable prices on other rates.

Demand Bidding Program

The Demand Bidding Program is a no-risk program whereby participants can earn credit for reducing their power use when requested to do so. This program is a flexible Internet-based bidding program that offers SCE customers with demands greater than 200 kW, the opportunity to receive a credit on their bill for voluntarily reducing power without incurring any financial penalty. By participating in the program, customers can also assist in alleviating power shortages in California as well as reducing their overall power costs.

Large Power Interruptible (Interruptible Service Program)

The I-6 Interruptible Program provides lower energy and time-related demand charges for that portion of power usage a customer is willing to interrupt when requested by SCE. This rate is now available only to eligible customers with a minimum of 500 kW who are adding new load, or are new to SCE's service territory. Interruption events are limited to 1 event per day, 4 events per calendar week, and 25 events per year. An event will not exceed 6 hours, and the total periods of interruption will not be more than 40 hours per month or 150 hours per year.

The Scheduled Load Reduction Program (SLRP)

The Scheduled Load Reduction Program (SLRP) offers a bill credit to qualifying SCE bundled-service customers that have an average monthly demand of 100 kW or more who voluntarily commit to reduce at least 15% of their maximum demand, but not less than 100 kW per hour, during pre-scheduled weekdays and time periods. The program is available for the summer season.

SCE Energy$mart Thermostat℠ Program

This interactive demand response pilot program tests new technology for controlling air temperature and reducing bills. Participants may save money on electric bills, earn up to $150 for reducing energy use, and receive a new digital programmable thermostat (installed and programmed at no charge).

SCE installs at the customer's facility a pre-programmed thermostat connected to SCE via the Internet. SCE will monitor and alter the thermostat based on test needs during summer weekdays from May 1 through October 31.