Table of Contents

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Important:

This document and the associated webinar is a cooperative project of Maui Electric Company, Ltd. and Hawaiian Electric Company, Inc.

Hawaii Is Committed to Becoming Energy Independent

For many years, the state of Hawaii has shown a strong commitment to conserving energy and to implementing energy efficiency improvements. And we now realize we must do even more to become energy independent.

“Almost all of Hawaii's electricity now comes from a few [large] generators, which burn oil imported on a never-ending line of tanker ships. Hawaii would rather get electricity from wind.” (Ben Markus, National Public Radio)

Hawaii acquires 90% of its energy from petroleum, and according to the Hawaii Clean Energy Initiative, this makes it “the most fossil fuel dependent state in the nation.” Of that, 30% is used for generating electricity. The rest is mostly used for transportation.

But the goal of Hawaii through the Hawaii Clean Energy Initiative is to become less dependent on fuel oil. The goal is to achieve 70% clean energy by 2030 with 30% from efficiency measures, and 40% coming from locally generated renewable sources.

People in Hawaii want to increase the use of natural, renewable energy resources, such as wind power, geothermal, solar water heating and photovoltaic panels. Using renewable energy resources with energy conservation efforts will help to stabilize state-wide electricity rates and contribute to Hawaii’s clean energy future.

Another important strategy includes demand response programs—a proven way to help achieve Hawaii’s energy independence.

Opportunities for Demand Response

Demand response (DR) is a partnership between a business and the electric utility company, in which a business reduces electricity use (or demand) in response to requests from the utility. In return, the utility company compensates the business with bill credits for temporarily reducing electricity use.

Businesses that qualify and participate in DR programs can contribute to a more efficient and economical generation supply and help to reduce or eliminate rolling blackouts or brownouts. DR programs are designed to give certain facilities control in managing the demand for electricity during critical peak periods.

Many individuals whose business could benefit from these programs are unaware of the opportunities available to them. They are unfamiliar with methods they can use to reduce energy demand in their business or facility.

Demand response programs also help the environment. Through DR, production is reduced from power plants that are less efficient and more expensive to operate. This reduces Hawaii's emissions that contribute to global warming.

When Peak Demand Needs Peaking Supply

The chart below shows how base load, cycling, and peaking generators typically serve the need for electricity, referred to as "load."

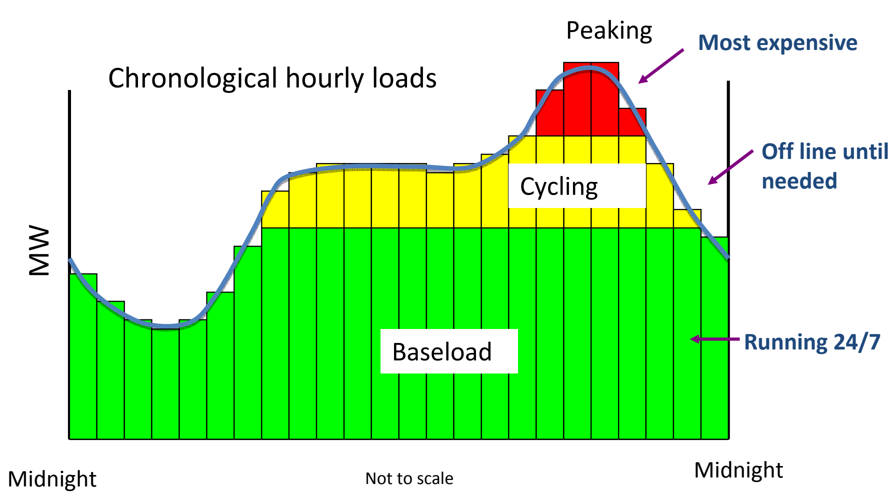
Base load generation units run 24 hours a day, 7 days a week. These can increase or decrease output as needed (within certain top and bottom limits) but they ramp up or down slowly compared to other generation. They are also referred to as spinning (operating) reserve. This is the cheapest electricity we create.

Cycling power generation units are kept off line until they are needed. They can ramp up relatively quickly, but not instantly. These are also referred to as non-spinning (off line) reserve. These are more expensive to operate than base load power.

Peaking resources (also non-spinning) are only brought on line for a short time when energy needs are at their highest. These are diesel combustion turbines that ramp up very quickly and they are the most expensive to operate.

Short term peaking generation can ramp up very quickly to meet temporary peaks in demand, but is the least efficient and very expensive to operate.

Demand response can be used to lower system demand and to avoid use of the most expensive peaking units. Demand response also can be used as a backup for intermittent power resources such as solar or wind generation.



Resources used to serve demand

What is Demand Response?

Demand response (DR) involves taking actions that lead to a reduction in electrical load.

“Load” or “demand” is defined as an end-use device, or the total power requirement of a site. Demand is usually measured in watts, kilowatts (kW = 1,000 W), or megawatts (MW = 1,000 kW).

Demand response programs are dynamic and temporary, and are designed to encourage a reduction in energy use during designated high demand periods when overall electricity use is at its highest, or when power grid integrity may be at risk.

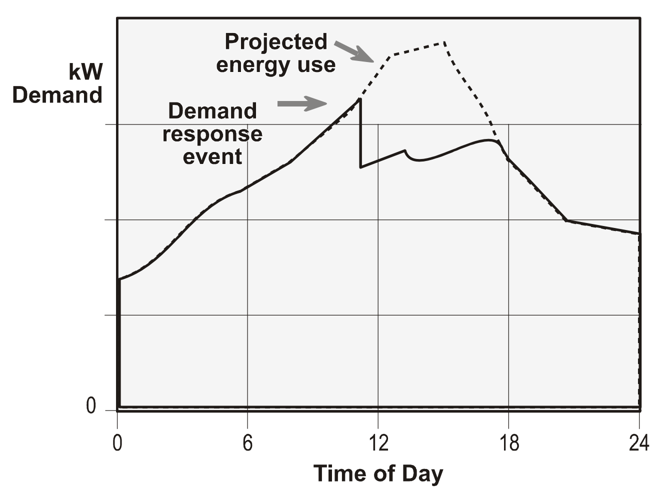
Demand response is used primarily as a resource for short-term immediate conservation by means of electric load shedding in response to pricing or reliability signals.

- “Shedding load” and “load curtailment” both refer to the act of turning off or reducing the operating level or number of devices that use electricity.
- “Curtailable load” refers to load from equipment or lighting that can be immediately reduced or shut off.

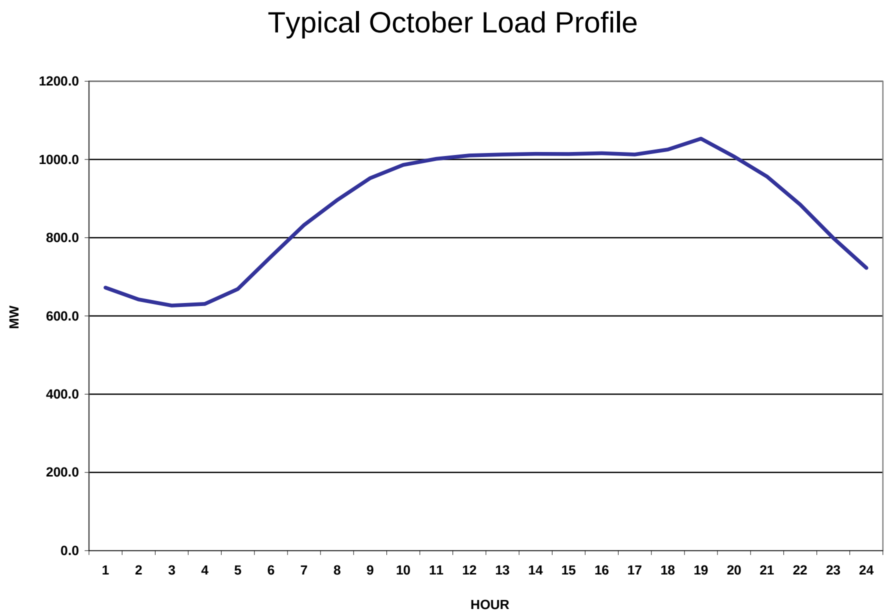
For Oahu, winter peaking DR situations are the most common, and are caused by concurrent high system demand. Facilities reduce load either manually or using automated technology such as an energy management system (EMS) or enhanced automation.

In Oahu, electricity load starts peaking in the morning around 10:00 a.m. and stays high until about 8:00 p.m. The lowest demand is typically between midnight and 5:00 a.m.

Curtailment requests also can occur any time of the year by electricity shortages that are the result of transmission or generation constraints. Occasionally, there are requests for local area curtailment to alleviate local problems.



The chart below represents the average hourly net Hawaiian Electric system load for a typical month of October. This shows that the energy use rises to a sustained level of 1,000 MW at about 11:00 a.m. and peaks at about 7 p.m.



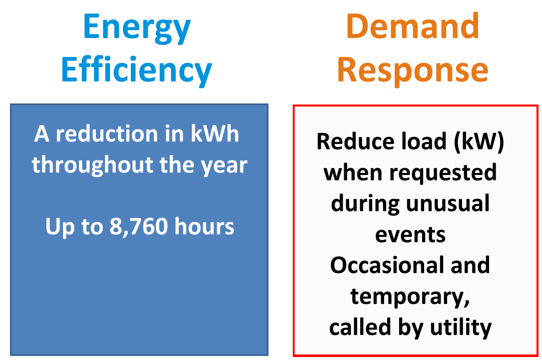
Average daily load profile for Hawaiian Electric territory

Historically, 88% of the highest system load hours occurred during the hours of 12 noon to 8 p.m. during July to November. High system load hours occur more often in the afternoon hours of 1 to 5 p.m. in July, August and September. Starting in September, the afternoon peak declines and high system loads occur more often between 6 and 8 p.m.

Efficiency vs. Demand Response

There are differences in conservation measures:

- **Energy efficiency** measures, produce a reduction of energy use (kWh) throughout the year.
- **Demand response** is an occasional, short-term reduction in load when requested by the utility companies during unusual events. With demand response, you are compensated based on capability and load reduction.



Characteristics of Demand Response

Demand response has some specific characteristics:

- **Demand response actions are taken specifically when requested**—usually when peak electric demand is approaching peak electric supply or when renewable resources unexpectedly drop off.
- **Demand response actions involve temporary, uncommon activities by consumers to reduce energy use, and is different from energy efficiency.** Demand response is a temporary action and is different from energy efficiency measures, which involve permanent actions.
  - If a facility has retrofitted the lighting system with new, energy efficient units, this everyday energy saving activity would be considered an energy efficiency measure.
  - If a facility has discovered it can save energy by shutting off a portion of the lighting on an everyday basis, then that behavior would not qualify as demand response since there is no further energy reduction available for curtailment requests if the lights are already turned off.

  Depending on the type of program, businesses participating in DR are notified anywhere from one day, to one hour, to 10 minutes prior to the curtailment, or in the case of instantaneous or immediate participation, as it is happening. Typically, the faster the response (the shorter the notification time), the greater the payment. Notification may be given by means of email, text, or phone call.

  A Hawaiian Electric revenue meter is required to measure the amount of electric load used during the requested periods and is compared with an established baseline demand level.

- **Programs are voluntary.** Demand response programs are voluntary, and usually open to commercial, industrial, and residential users who have certain minimum demand levels. Non-voluntary participation occurs during a blackout.
- **Typically pays incentives.** As a rule, participants receive payments or credit for each kilowatt of load curtailed or made available for curtailment, depending on the program.

Hawaiian Electric DR Programs

Hawaiian Electric currently has both residential and commercial demand response programs.

Residential Demand Response

Water heaters and air conditioners are the home's largest energy users. Water heaters alone make up about 30% of your electric bill. When electricity supply is less than electricity demand, there are ways you can help by being an EnergyScout™.

Residential Direct Load Control (RDLC) Water Heater (EnergyScout™)

NOTE: EnergyScout for Water Heaters is currently fully subscribed but Hawaiian Electric is working with the Public Utilities Commission to expand the program starting in 2013. Please check the Hawaiian Electric website (www.heco.com) for updates on this program.

With EnergyScout, Hawaiian Electric installs a free device that can turn off your water heater during system peak usage, typically for no more than one hour at a time. Hot water stored in your tank can still be used normally. By participating in the program customers receive $3 every month as a bill credit on their electric bill, whether or not an event is triggered.

Over 34,000 customers participate in the water heater program. Collectively, this represents nearly more than 15 megawatts of controllable peak demand, the equivalent of the energy produced by a power plant.

Residential Direct Load Control (RDLC) Air Conditioner (EnergyScout™)

NOTE: EnergyScout for Air Conditioners is currently fully subscribed but Hawaiian Electric is working with the Public Utilities Commission to expand the program starting in 2013. Please check the Hawaiian Electric website (www.heco.com) for updates on this program.

With EnergyScout for Air Conditioners, Hawaiian Electric installs a free a device that can temporarily cycle your central air conditioner, typically for no more than one hour at a time. Air conditioning will continue to run, but for short periods. By participating in the program, customers receive $5 every month as a credit on their electric bill, whether or not an event is triggered.

Over 4,000 customers now participate in EnergyScout for Air Conditioners. Collectively, this represents more than 2.5 megawatts of controllable peak demand.

Commercial and Industrial DR Programs

The Hawaiian Electric companies also offer commercial and industrial DR programs.

Commercial and Industrial Direct Load Control (DLC) (EnergyScout™ for Business)

NOTE: EnergyScout™ for Business is currently fully subscribed. While we continue to maintain DLC program operations, we do not have plans to expand our current program. Interested customers should consider Fast DR.

With EnergyScout™ for Business, Hawaiian Electric installs a free device that can temporarily curtail customer designated loads, typically for no more than one hour at a time. Current program participants have designated from 50 kW up to 5 MW of curtailable load. In return, DLC participants receive monthly incentives in the form of bill credits or checks. Monthly incentives are paid regardless of whether a DR event occurs or not. When a DR event is triggered for more than one hour, participants receive an additional Energy Reduction Incentive.

DLC participants participate at two different levels: (1) Dispatch or (2) Dispatch & Under Frequency. In the Dispatch scenario, customers have one hour after notification to drop their load. The device Hawaiian Electric installs senses the drop in system frequency, curtails loads immediately and then sends a notice that an under frequency event has occurred. Currently, 43 customers participate in the DLC program, representing 18.2 MW of controllable peak demand.

Fast DR Program

Fast DR is designed to reduce electricity use in near real time in response to grid changes, such as unexpected spikes in energy use; when electricity generation may not be sufficient to meet peak load; or sudden drops in wind or solar generation. For commercial and industrial customers that qualify, Hawaiian Electric places automatic or semi-automatic controllers on nonessential equipment.

Any commercial or industrial customer that can commit to a minimum of 50 kW for demand reduction is eligible for Fast DR and will receive a yearly credit of $3,000 ($250 per month), or more depending on the actual demand reduction, whether or not a DR event is initiated.

Finial enrollment depends on results of a Technical Audit that includes evaluating the facility energy profile and recommending DR load plans.

For more information, see the Fast DR brochure reproduced at the end of this document.

Pending Commercial and Industrial Dynamic Pricing Pilot Program (CIDP Pilot Program)

The CIDP Program application was submitted to the Hawaii Public Utilities Commission on December 29, 2011. If approved, the CIDP Pilot Program could start as early as 2013. The proposed CIDP Program is intended to offer tariff-based dynamic pricing options to participating commercial and industrial customers for a two-year period. Dynamic pricing allows customers to respond to the changing cost of electricity by curtailing their demand in response to changes in the retail price of electricity. The CIDP Pilot Program proposes reducing the demand charge for commercial and industrial program participants in return for their lowered energy use at certain times (and sometimes on short notice).

Under the pilot program, a program participant will designate a firm service level (FSL), a level of kW demand that is significantly lower than normal operating use, but sufficient to safely and efficiently operate the participant's facility for limited periods of time. A participant would agree to reduce facility demand to the FSL when a DR event is initiated. In return, the participant receives a reduced monthly demand charge for each kW of demand difference between the actual demand and the FSL, whether a DR event is called or not. During a DR event, a participant may choose the level to which they reduce their load: to or below the FSL, above the FSL, or not at all. If the participant chooses not to reduce load to or below the FSL, the participant will pay a "buy-through" energy price for the duration of the DR event for kWh above the FSL. The buy-through energy price is several times higher than the otherwise applicable tariff energy price.

The Electric Grids

Electric utilities in Hawaii are unique—each island maintains its own electrical grid for power distribution, and supplies all of its own generation. Utilities in Hawaii must maintain the stability and integrity of each island's electrical system without the benefit of support from larger, external grids.

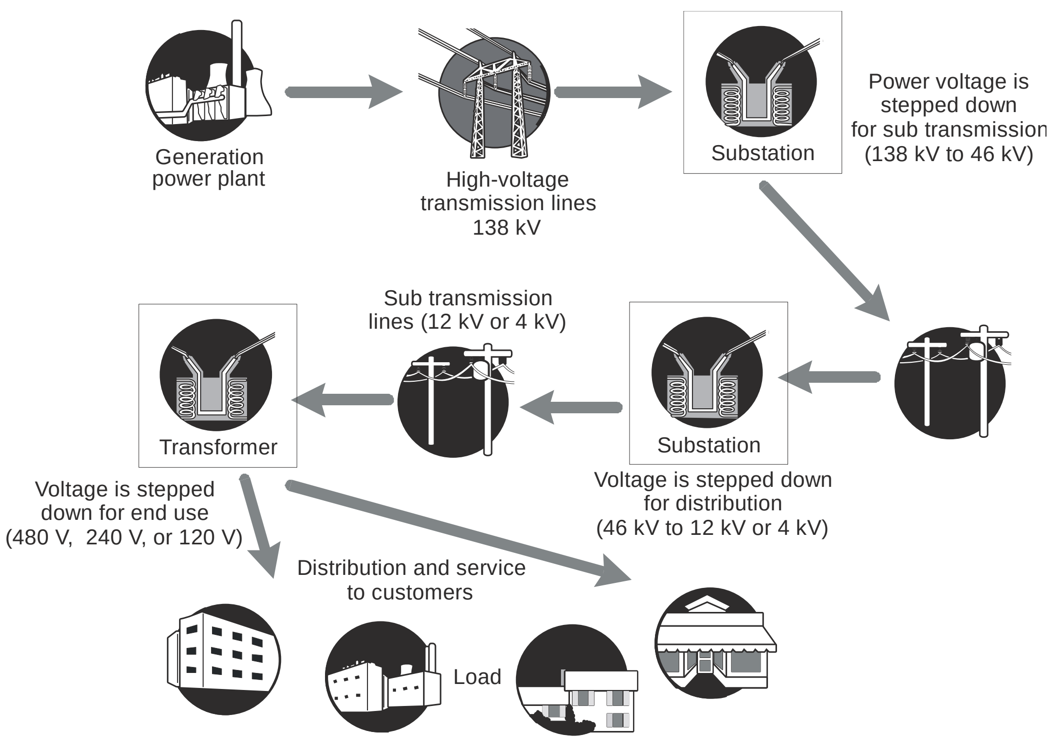
There are many participants in Hawaii's electricity distribution system, and the system depends on each of them to function smoothly.

The Hawaiian Public Utilities Commission controls the transmission system and monitors transmission security for Hawaii.

On Oahu, Hawaiian Electric's 138,000-volt (138 kV) transmission lines transport bulk electricity to transmission substations. These substations reduce the power to 46 kV. Then 46 kV lines go to local area distribution substations, which further step down the voltage to 12 kV or 4 kV. These lower-voltage distribution lines are further stepped down to 480, 240, or 120 volts and connect to businesses and homes.

Other islands use different voltages for their transmission and distribution systems.

Electricity travels through a network or grid of transmission and distribution lines from power plants and substations to customers. On Oahu, most of the power is generated by plants located on the west side of the island. Electricity is delivered throughout the island through two primary transmission corridors—one in the north and the other in the south.



Generating Reserves

The stability and reliability of electricity supply systems is essential; utilities must be able to balance the supply and demand for electricity virtually instantaneously at all times. Generating reserves are necessary to maintain this balance.

An electric utility company achieves a reliable operation of the transmission system by maintaining sufficient generating reserves.

There are two basic categories of generating reserves:

- Spinning reserves
- Non-spinning reserves

Spinning Reserves

The generation plants or devices that are producing electricity at any given time provide spinning reserves. Hawaiian Electric's steam generation plants are one example. These plants regulate the voltage and frequency by following the load as it rises and falls throughout the day.

- If a major generating facility is forced off line, spinning reserves can be "ramped up" quickly to meet demand.
- Spinning reserves are achieved by running some of the generating units on the system at less than full capacity.
- Spinning reserves are often required to meet demand when intermittent renewable energy sources like wind are present in the generation mix.

Non-spinning Reserves (or Supplemental Reserves)

Non-spinning reserves are generation facilities that are not connected to the system until they are needed. These are also referred to as "stand-by generating capacity."

Non-spinning reserves are generating units that can be started and synchronized with the electric system within a given period of time—e.g., 10 minutes, one hour, or 24 hours. One example are the "peaking units" such as turbine generators that start up to meet the highest peak system demand.

Generating Reserves and DR

For some operating requirements, generating reserves and DR are interchangeable. Specifically, DR can be substituted for generating capacity used for:

- Day-ahead operating reserves—reserves that must be scheduled a day in advance of system operations. These are based on the economic dispatch of available generating resources and projected demand.
- Hour-ahead—reserves—these are scheduled at least one hour ahead of system operations and are based on the projected availability of generating resources and projected demand.
- Ten-minute operating reserves—these must be operational within 10 minutes after a notice to respond to unanticipated changes in the available generating resources.

DR can be used to lower the cost of supplying electricity in two ways:

- As one-hour and day-ahead reserves, DR can delay the investment cost of generating capacity expansions.
- As 10-minute reserves, DR may reduce the need for spinning reserves. DR within 10 minutes can act as a bridging resource to balance supply and demand when the intermittent renewable energy sources (such as wind generation) have decreased. This type of DR can also help avoid the need tor additional generation.

There are several benefits:

- Participating facilities may select the level of service they desire at the lowest possible cost.
- Non-participating facilities will benefit from improved reliability and lower cost
- The utilities will benefit from improved operating performance, lower investment costs in generation and improved customer satisfaction.

Wind Energy

Hawaii's shift to renewable energy depends heavily on wind. As wind can help support the need for electrical generation, DR can help support a reduction in wind generation when "rapid and sustained decreases" in wind production occur.

About 97% of the time, winds in Hawaii vary from moment to moment within a predictable range. These fluctuations can be controlled with conventional spinning reserves—the plants that are up and running simply ramp up to meet the need.

However, during the remaining 3% of the time, sudden, large, and sustained reductions in wind production occur. These rapid changes can occur unexpectedly, and with wind in the production mix, require larger reserves to operate than would otherwise be required. It is the cost of these additional reserves that the wind support DR resource is designed to avoid.

During these times when these changes in wind production fluctuate widely within 10 minutes, substantial generating reserves are needed fast.

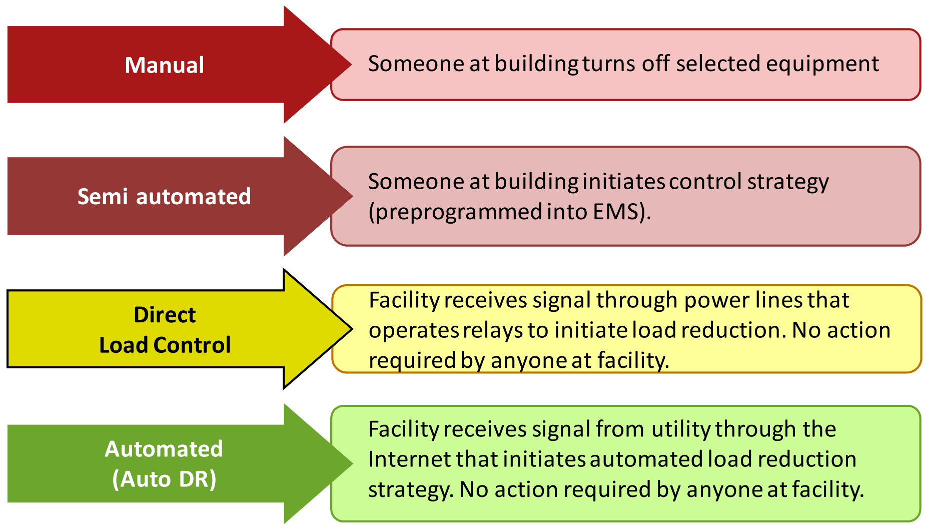
Before wind resources were added to the electrical generating system, Hawaiian Electric balanced the system with about 180 MW of spinning reserve.

Facilities used as spinning reserves ramp up production in response to supply fluctuations and provide enough time for other resources to come online in the event of forced outages of other units on the system. Hawaiian Electric currently does not have fast-start generators that can start and synchronize with the system in less than 10 minutes. This is where fast demand response comes into play.

DR Strategies

Direct load control, also called dispatchable load shedding, is an automatic type of demand response that sends a signal that activates a relay, which in turn initiates an energy use control strategy. Response is in less than 10 minutes.

For Hawaiian Electric, automated DR does not necessarily require an energy management system (EMS). The controller may be some other type equipment at a facility that is activated such as a relay switch to trigger load control.



Semi-Automated Demand Response

With semi-automated demand response, the utility company notifies the facility (a phone call, e-mail, or text) that there is a need for reduced energy use, then a facility shuts down equipment or lighting based on a pre-determined strategy.

Usually an operator at the facility gives instructions to the EMS that carries out a set of instructions to curtail load.

Automated Demand Response (Auto-DR)

Automated Demand Response (Auto-DR) enables facilities with automated load control systems, such as an EMS, to participate in demand response events without manual intervention. This results in rapid, highly reliable load reductions.

Hawaiian Electric sends signals to your building through a DR Automation Server. The building receives the signal through a device installed at your site that initiates the pre-defined routines to reduce demand. This is a "machine-to-machine" process, requiring no human intervention or effort. A phone call, email, or text is sent to a designated facility representative upon event trigger.

Participants may design and pre-program levels of participation and automatically take part in a demand response event.

How Does Auto-DR Work?

Simply put, Auto-DR connects the utility company system to facility systems to enable automated (unmanned) load shed for DR response. Auto-DR technology makes it possible for a facility to automatically achieve specified demand reductions (kW and duration) during demand response events.

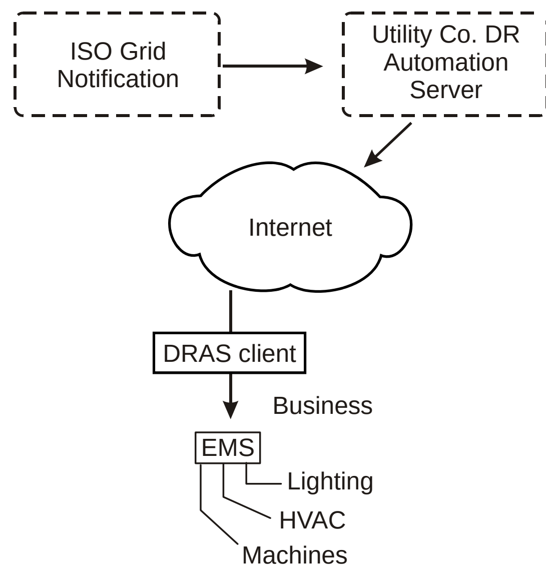
One component is the Demand Response Automation Server (DRAS) that is manufactured by Akuacom. This is a messaging infrastructure.

The DRAS receives information about DR events from the utility company. The DRAS software issues a DR event, sending signals over the Internet to gateways at the participating facilities.

In turn, the EMS automatically executes preprogrammed load-shed measures, such as cycling air conditioners, and turning off non-essential lights through Building Automation Systems (BAS) and/or load controllers.

Auto-DR is designed to save money and energy by offering financial incentives in exchange for shifting or reducing energy use during critical energy demand periods.

Participants are in control because they can design and pre-program their own electrical load reduction strategies.



Who the Businesses Are—the Big Picture

In this section we explore some specific types of 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.

We divide them into two large groups:

- “People Buildings” which include offices, retail facilities, hotels, educational facilities, administration facilities, hospitals, and so on. When these businesses participate, they may be trading energy savings for comfort and convenience.
- “Process Facilities” which include manufacturing facilities, cold storage, pumping applications, and so on. When these businesses participate, they may be trading energy savings for changes in productivity.

We will look at various market segments and discuss which ones are good candidates for demand response and why. We can learn to identify the best opportunities by the type of facility or business and often can use their load profile (load shape) and billing history as a screening tool.

As a rule, many industrial loads can be shifted to off hours without adversely 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%.

Potential Demand Response Loads for "People Buildings"

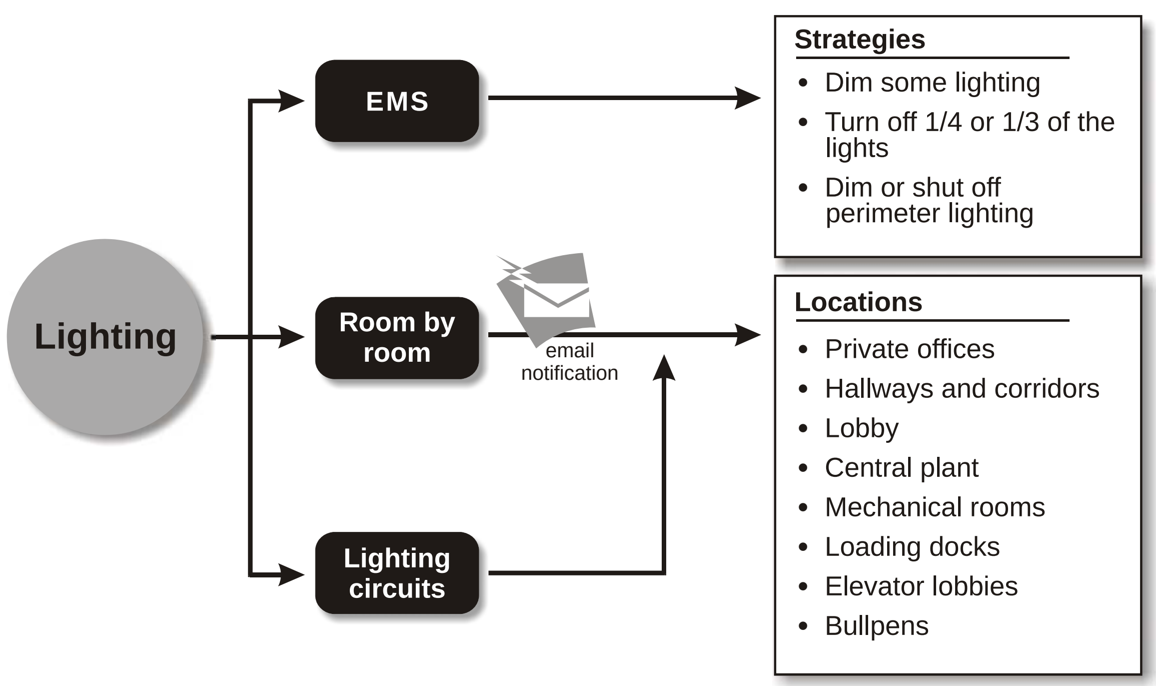
For commercial facilities, there are specific areas where you can find curtailable load.

Lighting

Because lighting produces heat, reducing lighting levels will reduce the cooling load within the space. This is an "interactive effect" and results in about a 20% additional kW reduction in cooling for each kW reduction in lighting. Occasionally you will find a dedicated EMS just for lighting, or some type of special lighting control system.

There are several demand response office space lighting strategies and technologies for lighting:

- Use specific switching or dimming strategies:
  - Lower lighting levels using a dimmable lighting controller (EMS or manual)
  - Bi-level switching, (to 2/3 lighting level, etc.); bi-level control allows one or more lamps per fixture to be shut off (manual)
  - Shut off 1/3, 1/4 or selected parts of the lighting (EMS)
- Turn off or reduce perimeter lighting (lights near daylight windows) or in areas with skylights. In other words, use daylight when possible.
- Turn off entire lighting circuits at the breaker panel, either with the EMS or manually



- Retrofit your lighting to use **special types of ballasts**:
  - To switch some lamps off
  - To dim lamps to discrete levels
  - For continuous dimming
  - Digitally Addressable Lighting Interface (DALI)
  - Demand Control Lighting (DCL) system controls
- **Hallway or corridor lighting (common areas).** 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. (As part of a demand response strategy, emergency circuits should be used with caution and in accordance with applicable local safety codes.)
- **Stairwell lighting.** In buildings with elevators, many stairwells are over lit. This means a portion of these fixtures can easily be temporarily shut off or dimmed. If this approach is used, make sure that there are no locations that are too dark, which might make them 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 displays, and decorative 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.
- **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. Recessed lighting and high ceiling and open warehouse lighting also present opportunities.
- **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.

Lighting Methods for Demand Response

There are four methods or strategies that use existing technology that can be used to comply with DR requirements:

- Bi-level wiring
- Addressable lighting system
- Centralized powerline dimming control
- Digital zone based system

If the system can shed load in a way that "maintains functionality of the spaces affected," it is considered demand response enabled.

A centralized lighting network can be connected to a timeclock or a control panel that has timeclock functionality built into it. Or each space can be connected to occupancy sensors, which meets the requirements for automatic shutoff control without the need for a timeclock. In this case, a zone based lighting system will apply, which utilizes network adapters to enable each room to be monitored and controlled for demand response.

Each of the four mentioned methods meet DR capability requirements since they are connected to take advantage of multilevel lighting control.

- These methods will require adding specific components and control wiring to enable DR capabilities that can take advantage of the increased granularity of the lighting controls. Also, the controllable lighting will be connected to a junction box within a zone.
- An option is to install individual ballasts that are Internet Protocol (IP)-configured that can receive the demand response signal directly. However, enabling DR lighting will most likely entail a single entry point for the DR signal that is then connected to all of the controllable lighting in the floor or the building. A reasonable location to receive the DR signal is at the existing lighting control panel, often located in the electrical room. Alternatively, a zone based digital lighting system could require adapters installed in each room and networked together to enable DR capabilities.

Bi-Level Wiring

This method enables multi-level control.

- Multi-level controls are required to have at least one control step that is between 30% and 70% of design lighting power. The minimum step (30%) used for DR load shed is a conservative amount.
- Switching off 15% of the lights in an eligible space or building is a simple and effective means of enabling demand response.
- Designing the circuits so that all of the "demand response lighting" is on the same circuit allows for the use of relays to shut off the DR circuit upon reception of a demand response signal.
- Depending on the layout, enabling demand responsive lighting could require some additional wiring.

Addressable Lighting System

A centralized control panel is limited to controlling in unison an entire channel or circuit. However, with the addressable lighting system, each fixture can be addressed individually.

Enabling DR for the addressable lighting system requires making a dry contact input available to receive an electronic signal. This is a feature that is included in most lighting control panels.

Some smaller addressable lighting systems have some inputs dedicated for alternative uses, such as a timeclock. If this is the case, an I/O input device can be added to the network to provide an additional closed contact input. This device can then transmit that signal to as many as five local node controllers, and each local node controller can serve up to 100 ballasts (approximately 5,000 sf).

Centralized Powerline Dimming Control

An effective method for enabling DR in smaller buildings uses a type of powerline carrier signal with a system that has centralized control of dimmable ballasts. This method requires a lighting control panel downstream of the breaker panel.

Circuit controllers, which replace lighting circuit relays, send the dimming signals through line voltage wiring.

The panel has seven dry contact inputs that are dedicated levels of demand response. Different channels can be assigned to have different levels of dimming as part of the demand response. Local controls can be provided by either line voltage or low voltage controls.

If there are two different signals being sent to a particular group of ballasts, the system uses the lowest setpoint by default. This means that upon reception of a DR signal, if the default response is to set the ballasts to 70%, and a room is already set to 50%, it will stay at 50%. Any ballasts set higher than the demand response level will be trimmed to the programmed level. The level of response can be chosen when the system is programmed or reprogrammed, if the building occupant wants to change the setting.

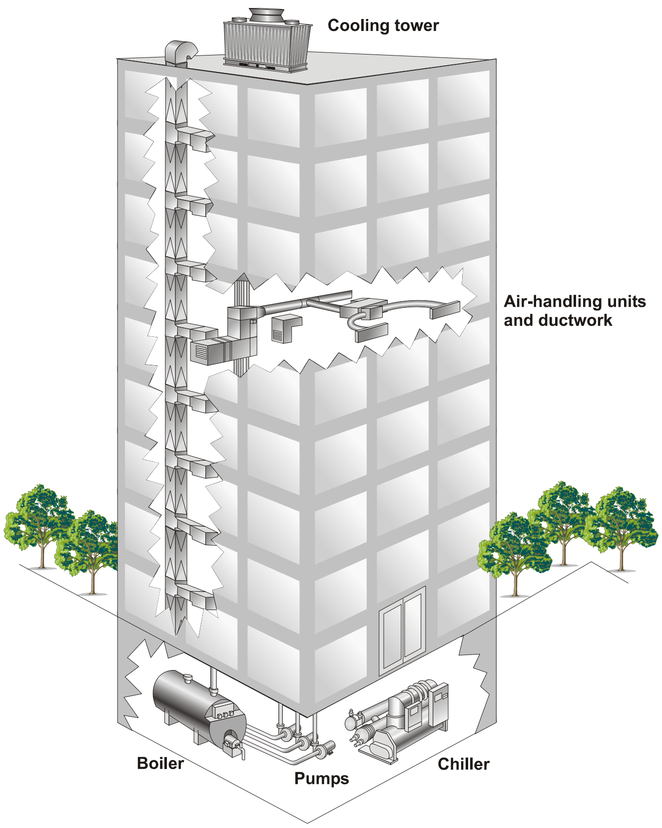
Digital Zone Based System

For a digital zone based system, enabling DR requires a network adapter being added to each room controlled for DR. The network adapters let the EMS monitor and control each room. Digital zone based systems are typically used for DR design and for HVAC systems.

To increase functionality in a new building by installing an EMS, it is worth adding the lighting network to the EMS and the existing DR system.

This would enable, for example, occupancy sensors to be used as triggers for the HVAC system, turning the A/C on and off when people enter and leave the room. The potential for savings from this type of system is higher than the value of the lighting load shed for DR.

Air Conditioning



Air Conditioning Strategies

There are specific demand response strategies for air conditioning, and the goal is to develop a plan that minimizes the discomfort of occupants. The transitions need to be fast enough to be responsive, but slow enough that occupants aren't noticeably affected.

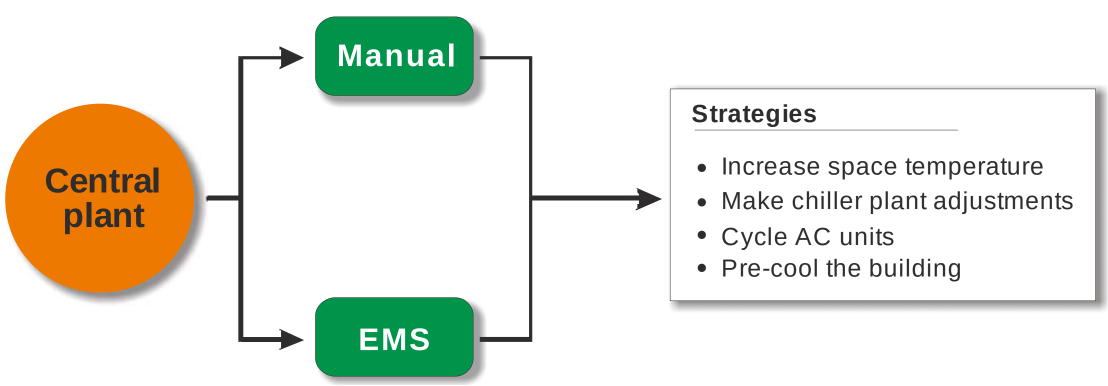
"Thermal inertia" can be defined as resistance to a change in temperature. Thermal inertia in a building affects the rate at which building materials change temperature, and relates to the ability of a building's mass to maintain a certain temperature given a change, such as when cooling is reduced. Building thermal inertia makes it possible to temporarily unload the HVAC system without an immediate impact on building occupants (in some cases, up to six hours without substantial occupant discomfort).

- **Increase space temperatures.** This demand response strategy simply involves raising space temperatures at the thermostats. Global temperature adjustment (GTA) is a zone control strategy that requires zone level direct digital control (DDC), GTA capability at the zone level, or the capability to program GTA at each variable air volume (VAV) box.

  GTA is typically done using an energy management system (EMS) and most HVAC systems are at least partially automated with an EMS. This method reduces the load of all air handling and cooling equipment, and each zone equally shares the burden of reduced service.

With GTA, operators can "easily adjust the space temperature setpoints for an entire facility by one command from one location." GTA is usually implemented by sending a signal from a central location to all thermostats. Reset could either raise each thermostat 2 to 4° F, or could raise all thermostats to a higher set point, say, 78° F. (Most energy management systems have this feature, or it can be added on.)

Caution with CAV systems: Applying GTA with terminal reheat systems (with CAV systems) may not provide savings, and could actually increase kW demand by adding boiler or terminal electric resistance heat. Verify the type of system before using this method for demand response.



- **Make chiller plant adjustments.** The following four techniques are similar and all result in higher chilled water temperature and lower demand on the chiller. However, all of these chiller plant adjustments result in increased demand from the fans and pumps. (See the caution below.)
  - **Reset chilled water (CHW) temperature.** This involves increasing the chilled water temperature setpoint. If the facility has constant air volume (CAV) air systems and constant volume chilled water pumps, reset the chilled water supply temperature higher (say, from 45° to 47° F). Generally, chiller power decreases by about 1.5 percent for each degree increase in chilled-water temperature, which reduces the load on the chiller. Also, less latent cooling occurs. Typically chilled water reset can be performed at the chiller panel or can be programmed through the EMS.
  - **Limit the cooling valve.** This technique is similar to chilled water reset and involves limiting or closing air handling unit cooling valve positions. This reduces water flow to the cooling coils and results in less load on the chiller.
  - **Limit chiller demand.** The control panel on most chillers have a way to restrict system loading or demand. Adjusting the setting directly controls the chiller compressor, and results in less load on the chiller.
  - **Reconfigure chiller lineup.** Usually central plants have multiple chillers, often of different sizes. Central plant demand can be reduced by alternative chiller loading—making use of fewer or smaller chillers and reducing pumping energy use by using smaller pumps.

Note: Generally, not all of these chiller plant adjustments are applied simultaneously in a facility. All provide similar results, so find the method that provides the easiest and most reliable demand response for your facility. Sometimes, an approach might entail using two or more adjustment methods over the period of the load curtailment.

Caution for all four methods: When chiller load is reduced for demand response, it will result in increased chilled water temperature, and usually in increased demand from the fans and pumps. For example, resetting the chilled water supply temperature in a variable-air volume (VAV) air system, or one with variable chilled water pumps, may cause an increase in fan power (as the VAV boxes open further due to less heat transfer at the coil) and increased distribution pumping. Unless the variable volume component speeds are fixed or locked (such as the VFD or inlet guide vanes), the demand savings from the increased chiller efficiency may be offset by the fans and pumps.

- **Pre-cool the building.** Pre-cooling commercial buildings is one strategy for meeting day-ahead load reduction. (Note that this describes a day-ahead DR strategy, and cannot work with DR programs that require a fast response).

  The idea is to use the energy for cooling the night before or early on the day of an alert, and less energy use after the alert is called. This requires setting the building temperature down 2 or 3 degrees, either the night before or the day of the alert. This action will pre-cool the building mass, and will have chiller water pre-cooled throughout the system. Then, the next day, the thermostats are reset to a higher temperature than normal, letting the temperature rise slowly, while reducing the cooling plant demand.

  Because the pre-cooling typically occurs before normal working hours, this strategy requires control over all of a building's thermostats, as with an EMS using GTA. That is, for large to medium facilities, automation is needed to implement pre-cooling.

  A building with a lot of skylights and glass that allow the sunlight to enter the building are not well suited for this strategy—a building with less glass is better. A study performed by the Lawrence Berkeley National Laboratory reported no complaints from occupants as the temperature slowly rose in the afternoon.

- **Cycle package unit air conditioning.** By cycling (turning off) window, rooftop, or split air conditioning units, summer peak demand can be greatly reduced. Cycling these systems in groups, so that each group is off for about 15 minutes at a time, will cause only brief discomfort for occupants and will not harm the compressors.

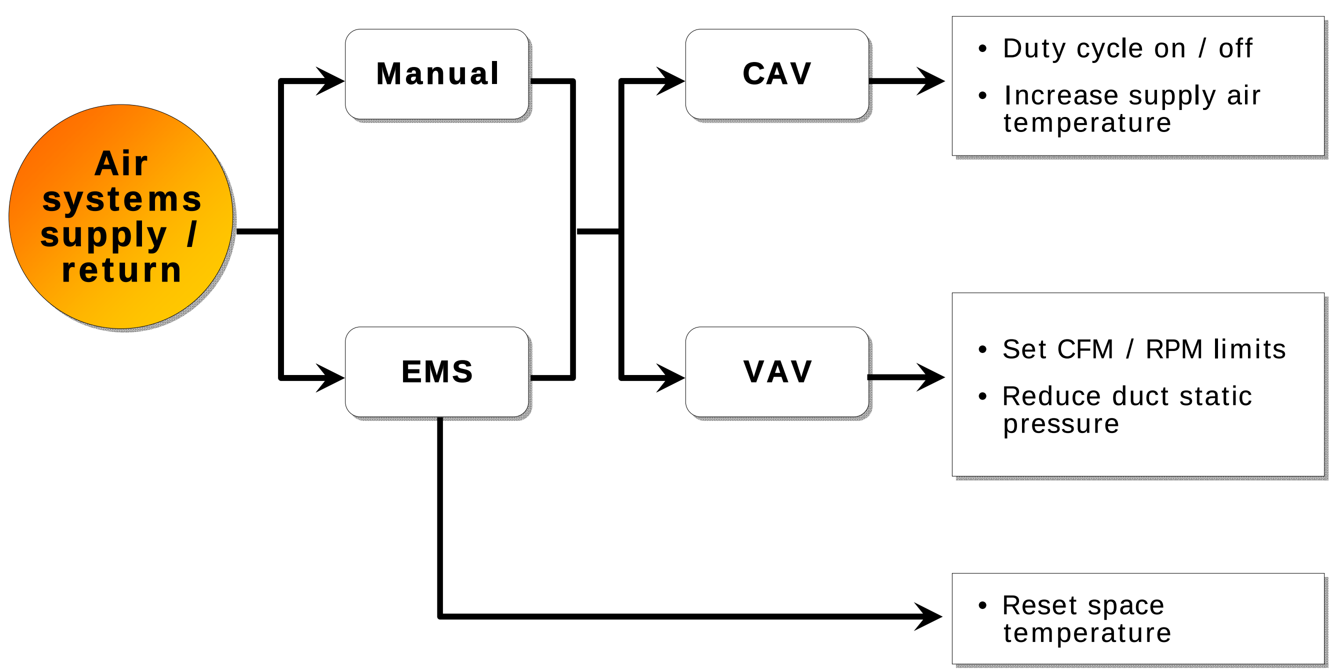
  When cycling air conditioning units, you can shut down only the compressor by itself or the compressor and the fans.

  Caution: Units may run for additional time after the demand response event is over to regain the desired temperature.

Air Systems Supply / Return

There are several demand response strategies for constant air volume (CAV) and variable air volume (VAV) **air systems**.

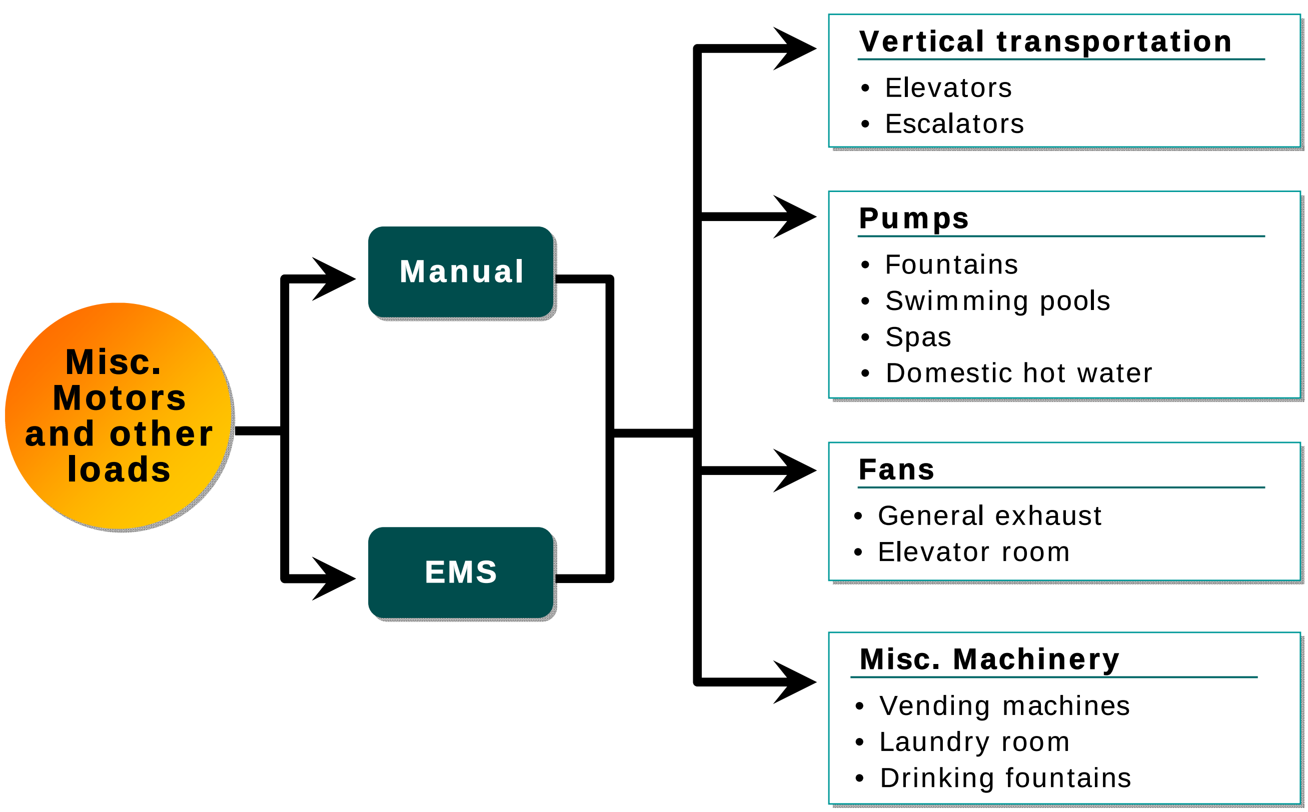
- **Cycle fans in CAV HVAC systems.** HVAC fans can be cycled (turned off) in sequence so that no fan is off for more than a brief period (say, from 10 to 15 minutes). Using this strategy, no one area is greatly affected due to building thermal inertia.
- **Reset duct static pressure on fans in VAV HVAC systems**. Duct static pressure setpoints are often set higher than necessary. On air handlers with variable speed drives (VSD), one strategy is to decrease the duct pressure setpoint (for example, from 2.0" water gauge [w.g.] to 1.5" w.g.). This can be done either manually at the VSD or using the EMS and does not usually reduce occupant comfort. Additional savings are realized when the duct pressure setpoint is set low enough to cause some VAV terminal boxes to "starve" from lack of air pressure. When airflow drops below levels required to cool the space, the load on the cooling system also drops. Using variable speed drives with HVAC fans is very beneficial—a 20% reduction in speed may produce nearly a 50% decrease in fan motor power demand. These strategies must maintain proper ventilation levels.
- **Limit fan speed.** For fans with VFD, the speed of the VFD can be limited to a fixed value during a demand response event. To be effective, the fixed value must be lower than what it would be during normal operating conditions.
- **Increase supply air temperature.** For CAV systems, increasing the supply air temperature reduces mechanical cooling demand. Caution: This strategy must avoid increased fan energy in VAV systems due to increased air flow. This can be done by limiting fan speeds or by locking the inlet guide vane position.



Other Machinery

Some strategies for miscellaneous motors and other loads include:

- **Cycle some 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.
- **Reduce pump and fan use.** Most buildings have pumps for domestic hot water (DHW) and other uses, and exhaust fans for elevators and general use.
- **Turn off all equipment not in use.** This includes office equipment such as computers, printers, etc.
- **Delay dishwashing and laundry processes.** These tasks can be scheduled for another time. Also, domestic hot water heaters can be curtailed (lowering temperature, duty cycling among several, or switching to non-electric sources).
- **Cycle 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).



Applications for Specific Types of "People Buildings"

Office Buildings

Office buildings offer potential for demand response, but each presents a challenge to meet the goal of shedding load and maintaining occupant comfort and productivity. The amount of load reduction can range from 2 or 3% to over 25%.

Owner-occupied and government buildings have a high level of participation in demand response programs with virtually no "comfort" complaints.

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 such as hallway lighting and ornamental lighting.

Other strategies include:

- Raise cooling thermostat settings.
- For air conditioning, some office buildings with package units can do load cycling, temperature reset, and possibly pre-cooling. Chiller strategies include CHW temperature reset or VSD speed control. General strategies include backing off fan speed or resetting duct pressure control. (Note that pre-cooling is a day-ahead DR strategy, and cannot work with DR programs that require a fast response).
- The printing facilities can operated during off-peak hours.
- Turn off equipment not in use and set computer equipment to sleep mode.
- Shutting down some vertical transportation (reduce use of multiple elevators).
- Use daylight in the afternoon and turn off unneeded lighting.
- Shut down vending machines for short periods of time.

Hotels and Motels

Hotels and motels may be able to reduce load in many different ways:

- Turn off ornamental lighting and some signage
- Turn off fountains and swimming pool pumps
- Use daylight in the afternoon and turn off all unneeded lighting
- Turn off other lighting such as hallway lighting, display lighting, and more
- Delay dishwashing and laundry processes
- Turn off ice machines
- Raise cooling thermostat settings
- Reduce central plant chiller loading
- Back off lighting and cooling in banquet halls
- Reduce use of elevators or escalators (the “down” escalators and some elevators)
- Delay use of battery chargers

Hospitals

Hospitals may be able to reduce load in these ways:

- Turn off ornamental lighting and some signage
- Turn off other lighting such as hallway lighting, display lighting and more
- Use daylight in the afternoon and turn off all unneeded lighting
- Delay dishwashing
- Delay laundry processes
- Turn off ice machines
- Raise cooling thermostat settings
- Reduce central plant chiller loading
- Reduce use of elevators or escalators

Retail Industries

Some larger retail industries can shed 50 kW or more during a DR event. Some opportunities for demand response include:

- Reduce the use of vertical transportation
- Shut down ornamental features
- Shut down marketing lighting displays
- Reduce air conditioning
- Reduce lighting to 2/3

Universities and Colleges

Larger schools, colleges and universities can be good candidates for demand response. Some ideas include:

- Use reset thermostats
- Reduce some lighting
- Shut down unused classrooms and facilities
- Review building utilization and scheduling
- Shut off swimming pool pumps
- Reduce lighting or appliance use in kitchens and cafeterias
- Reduce use of vertical transportation
- Reschedule energy-intensive laboratories

Other considerations for schools in the summer:

- School is usually over by 12:00 noon
- Lights and AC are often left on all day (after students are gone)
- Without students, the entire AC load can be shut off
- Custodians can be asked to shut down to emergency lighting

Potential Demand Response Loads for “Process Facilities”

There are many opportunities for curtailable load in industrial, manufacturing, assembly, and process facilities. This group will most likely adopt certain demand response strategies:

- Process facilities prefer manual override strategies for curtailing their processes over automatic control
- Rescheduling strategies are very common

Characteristics of “naturals” for DR include high-energy low-labor continuous processes or batch processes run by a few people that can be rescheduled to off-peak hours.

Facilities that operate 24 hours a day, 7 days a week are typically better at taking advantage of changing electric cost patterns and alternative load strategies. This is because they can be flexible with work schedules, and often can increase production or work processes during off-peak hours.

For process facilities, some specific areas you can find curtailable load include:

- Turn off all non-essential process equipment and pumping equipment.
- Delay batch and continuous processes. Batch processes can often be delayed to other times of day.
- Start production early, shut down at noon.
- Reduce or shut off indoor lighting.
- 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 at one time).
- Delay use of battery chargers, scrap grinders, baling machines and other nonessential process equipment.
- Outdoor lighting, signage, widow display, and decorative lighting.
- Curtail process loads that can be served by either a generator or an alternative fuel such as a gas-fired compressor. If on-site generation is available, it is most appropriately used with non-critical loads, such as pumps, fans, motors, domestic hot water heaters, but not loads that are sensitive to power variations, such as computers, electroplating, or interior lighting.
- Subcool refrigerated storage and let it “float.”
- Process extra product the day before and do only packaging the day of a call.
- Store water at high elevation the night before and deliver without pumps the day of a call.

Applications for Specific Types of "Process Facilities"

Manufacturing

Textiles and apparel

Printed materials

Manufacturing industries present many opportunities for demand response. These businesses can participate with a partial reduction in energy use, to a complete shut down of operations. Some can delay or shift manufacturing to non-peak times, and instead perform maintenance activities.

Examples of manufacturing in Hawaii include textiles and apparel, printing, oil refineries, stone, clay, and glass products.

As a rule, some manufacturing loads can be shifted to off hours without adversely 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%.

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

Manufacturing 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.

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 increase the product temperature from 10 degrees to 20 degrees.)
- Shut off evaporator fan or reduce the speed.
- Reduce or shut off unnecessary lighting.
- Secure fork lift charging.
- With day-ahead notice, pre-cooling may be an option.

Large "built-up" industrial refrigeration plant (ASW Engineering)

Food Processing

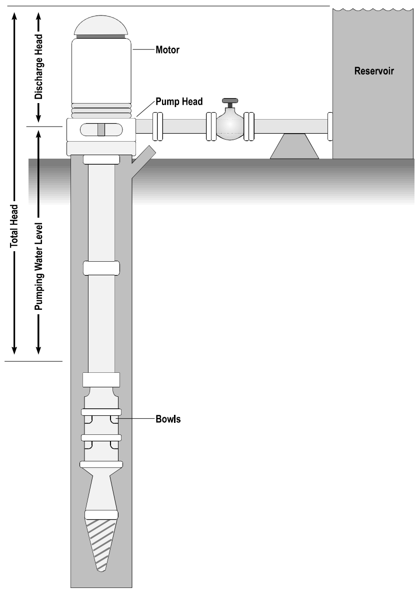
Some ways food processing facilities can participate in load curtailment include:

- 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 acceptable to increase 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).
- Facility can run late and produce and store extra product for packaging the next day

Food wholesalers also can participate in demand response:

- They can shut off some of the warehouse lighting based on system capability.
- In refrigerated storage, you can shut off refrigerant compressors and float for up to six hours.

Agricultural Water Pumping



Agricultural water pumping presents some possibilities for demand response.

- Turn off all non-essential pumping equipment.
- 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 candidate for demand response. Municipal utility companies often have not considered the possibilities for them 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.

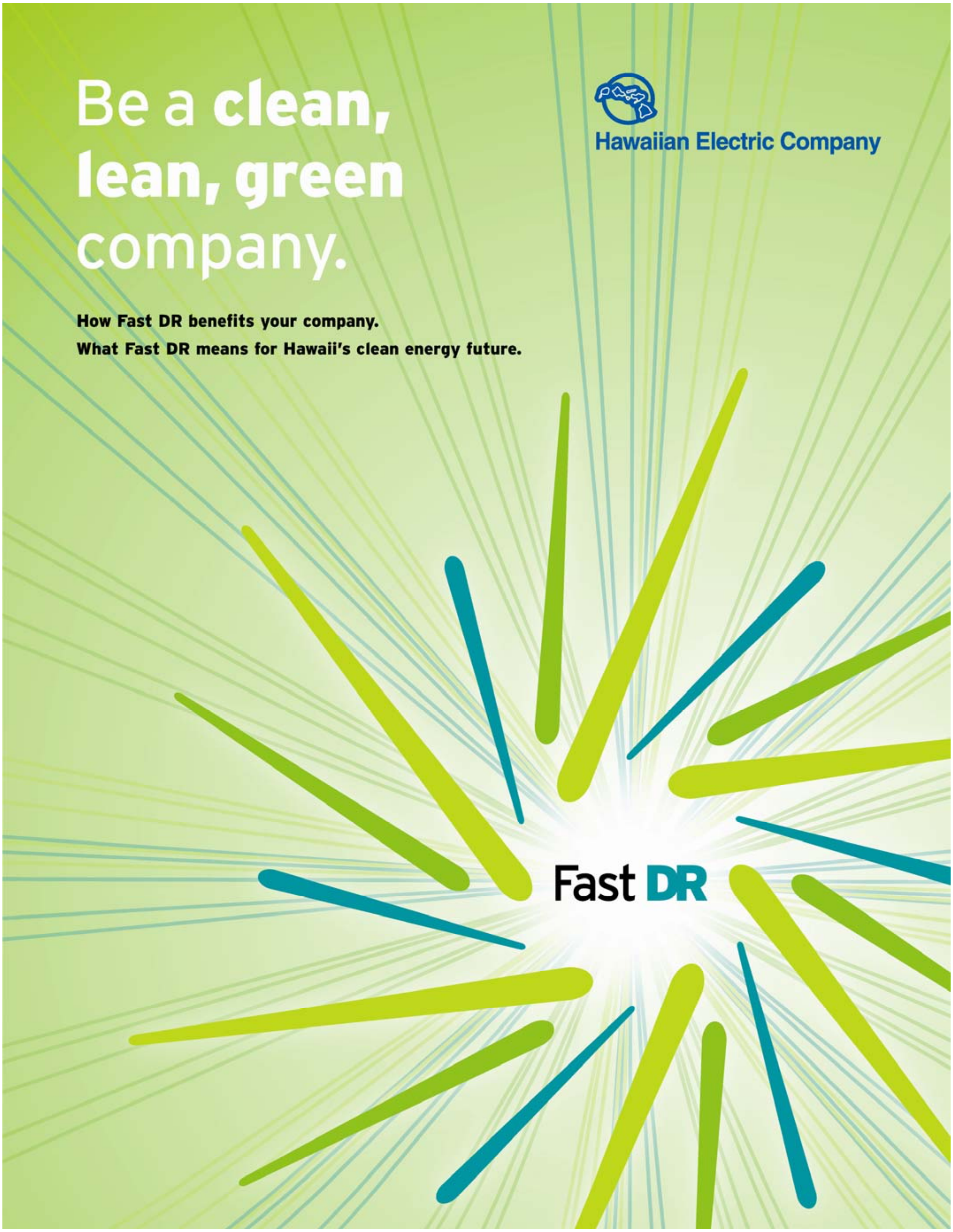
In some cases a curtailment program may cost-justify the construction of new storage facilities. Not only could they provide a contingency for demand response, but also a reserve in case the pumps fail.

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

Examples of Demand Response in Action—Process Facilities

Type of facility	% load reduction	How load is shed
Cold storage warehouse	35%	Shut off some compressors
Cold storage ice manufacturing	100%	Shut off all compressors
Manufacturing, building materials	50%	Shut off process motors and conveyor lines
Manufacturing, high tech	20%	Limited air compressor operation
Water district	100%	Shut off all pumps
Water district	90%	Shut off most pumps

Fast DR Program



What is Demand Response?

Demand Response (or DR) is a partnership between your company and Hawaiian Electric, in which you reduce electricity use (or demand) in response to requests from us. In return, we reward you with lucrative bill credits for temporarily reducing electricity use.

DR may also be used to help keep the grid stable and reliable, which helps keep electricity costs lower for everyone.

The utility may issue a request for demand response:

- During certain periods of peak energy use
- When grid reliability is jeopardized
- To assist in integrating or accepting renewable energy resources onto the grid

What is Fast DR?

Fast DR is designed to reduce electricity demand in near real time in response to grid changes, such as unexpected spikes in energy use; when electricity generation may not be sufficient to meet peak load; or sudden drops in wind or solar generation. For commercial and industrial customers that qualify, Hawaiian Electric places automatic or semiautomatic controllers on nonessential equipment.

While Fast DR requires some automation, your company always maintains complete control and can opt out of having your demand impacted at any time. You may not rely on backup generation during Demand Response events.

Typical loads to be reduced:

- HVAC use
- Nonessential indoor and outdoor lighting, signage and window displays
- Any nonessential process or equipment
- Fountains, saunas, pool or hot tub heating and pumps
- Excess elevator banks or escalators (as permitted)

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Fast DR
DR.HECO.COM

How does your company qualify?

Any commercial or industrial customer that can commit to a minimum of 50 kilowatts (kW) for demand reduction is eligible for Fast DR. Final enrollment will depend on results of a Technical Audit that includes evaluating the facility energy profile and recommending DR load plans.

Qualified customers will be enrolled in either Automatic Fast DR or Semiautomatic Fast DR. Hawaiian Electric will work with each customer to develop the best DR strategies, customizing a curtailment plan that maximizes incentive payments while minimizing the impact of operations. Additionally, Hawaiian Electric will fund enabling technology to help automate curtailments and in effect, automate energy savings.

Minimum requirements:

- Able to commit at least 50 kW for load reduction
- Allow the installation of load reduction equipment at your facility
- Agree to upgrade your meter with Hawaiian Electric's revenue meter

How does your company benefit from Fast DR?

Reduced Electric Bills

Companies that designate the minimum load requirement of 50 kW will receive a yearly credit of $3,000 ($250 per month), whether or not a DR event is initiated. If you can designate more, your company will receive an additional credit of $5 per kW per month. Electricity credits are also based on your company's participation level during DR events.

Energy Reduction Incentive

For each hour that energy is not consumed, your company earns an added energy reduction incentive of 50¢ per kW. Incentives are calculated for each DR event, based on the amount of energy your company actually uses compared to what would have been used (10-day Average Baseline) had the event not been triggered.

Installation Assistance

- A free, no-obligation evaluation will be performed to determine your facility's demand response opportunities.
- Free Preliminary Assessment and Technical Audit.

Installation Allowance

Your company will also receive up to $3,000 toward the cost of implementing any required metering infrastructure.

Other Upgrades

- Potential Building Management System upgrades available.
- Customers may be eligible for technology upgrades.

Access via the Web

Fast DR provides access to a secure website showing energy use data, demand response event history, and opt-out processing to temporarily withdraw from participation, either before or during a DR event.

Fast DR Basics

Load reduction available 7 am to 9 pm weekdays (excluding federal/state holidays)

DR events may last a maximum of 2 hours

Loads must be reduced within 10 minutes of event initiation

Maximum of 40 events per year for a maximum of 80 hours interruption

When a DR event is called, the customer-designated contact person will receive notification via a phone call, email or text.

Fast DR Step-by-Step

1
Schedule a Fast DR presentation, Preliminary Assessment and/or Technical Audit

2
Assist Hawaiian Electric in performing the assessments and/or audits

3
Review audit findings and decide if program benefits are worthwhile

4
Develop load reduction plans in conjunction with Hawaiian Electric

5
Determine equipment, software requirements and upgrades in conjunction with Hawaiian Electric

6
Sign Fast DR agreement with Hawaiian Electric

7
Arrange for installation of load reduction equipment, testing and commissioning

8
Begin receiving monthly participation incentives

Why is Fast DR important?

As the Hawaiian Electric companies move toward a grid composed of higher levels of as-available intermittent renewable generation (solar and wind), a Fast DR program can provide an additional resource to reduce demand until additional generating units are brought online. Also, Fast DR can provide demand reduction to temporarily postpone the need to bring generating units online, helping to reduce overall energy costs and Hawaii's dependence on imported oil.

For more information, call Fast DR at 94-POWER (947-6937) or visit dr.heco.com.

Hawaiian Electric

Definitions

Adjustment Factor	Adjustment factor (AF) is calculated as the difference in observed demand and estimated baseline for a calibration period of three hours starting four hours before event notification, with a maximum absolute adjustment value of 20%.
Automated Demand Response (Auto DR)	Automated Demand Response (Auto DR) enables facilities with automated load control systems, such as an Energy Management System (EMS), to participate in demand response events without manual intervention, resulting in rapid, highly reliable load reductions. Demand Response Automation Server (DRAS) software issues a demand response event sending OpenADR signals over the internet to a gateway at the participating facility, which in turn, automatically executes pre-programmed load-shed measures, such as cycling air conditioners, and turning off non-essential lights through Building Automation Systems (BAS) and/or load controllers.
Baseline	A Hawaiian Electric defined calculation methodology to calculate the average energy usage profile of a facility over a period of time.
Baseline Period	A Hawaiian Electric defined period of time over which the baseline energy usage profile of a facility is calculated.
Curtailment Service Provider (CSP)	A curtailment service provider (CSP) assists facilities in implementing strategic energy reduction initiatives and brokers those aggregated load reductions in capacity markets or utility-run demand response programs.
Curtailment Schema	Predefined load reduction strategies executed in response to DR event signals.
Demand Response Automation Server (DRAS)	The Akuacom Demand Response Automation Server (DRAS) software is a comprehensive, OpenADR demand response resource and event management tool, providing utilities visibility to and control of participating facilities' energy consumption and demand response load reductions.
Demand Response Event	The day and time period when a utility signals facilities participating in demand response programs to reduce energy consumption, typically due to a critical energy supply and demand situation.
Event Energy Reduction Incentive Payment	The additional per-kilowatt-hour electric bill credit given to facilities enrolled in Hawaiian Electric's Fast DR program when energy consumption is reduced in response to a utility-issued demand response event.
Event Load Control kW	The energy reduction resulting from curtailment schemas executed at a facility during an actual utility demand response event computed using the applicable baseline methodology.
Event Performance Factor	The adjustment factor that is used to calculate the capacity payment incentive. The factor varies between 0 and 1.2 and is based on the event performance level.
Event Performance Level	Event Performance Level is the ratio of Event Load Control kW and Registered Load Control kW.
Fast DR Program	A reduction in energy demand by commercial and industrial customers with 10 minute notice or less. Fast DR is frequently used to quickly reduce demand until additional generating units are brought online when output drops off from intermittent renewable energy sources.
Gateway	A hardware device installed at a participating facility. The OpenADR gateway continuously polls the Akuacom DRAS software for event schedule information. The gateway delivers the OpenADR signals to building automation system (BAS) and/or load controllers at the facility.

Monthly Capacity Payment	A monthly electric bill credit given to facilities enrolled in Hawaiian Electric's Fast DR program. This is based on facilities performance during curtailment events compared to the baseline.
Non-Performing Event	A facility opts not to participate to reduce load when the utility issues a demand response event.
Participating Facility	A commercial or industrial customer enrolled in a demand response program.
Registered Load Control kW	The energy reduction resulting from curtailment schemas executed at a facility during a measured and verified (M&V) demand response test event.
Semi-Auto DR	Semi-Automatic DR begins with a phone call, e-mail, or text to designated facility personnel who then shut off designated load manually or automatically.
Shadow Meter / Data Logger	Additional meter which may be installed on site in order to capture interval meter data for Audit analysis or customer dashboard population purposes.
Similar Energy Usage Days	Energy Usage days that are expected to have the same energy usage profile during similar time of the day. This typically excludes weekends and holidays.
Suspension from the Program	A customer is no longer enrolled in the Demand Response program and will no longer be required to participate and will not receive incentive payments.
Pilot Period	November 1, 2011 – November 1, 2013 – Term of Fast DR Pilot Program.

FastDR

Hawaiian Electric

Fast Demand Response Pilot Program
PROGRAM RULES
ATTACHMENT A
Issued: June 28, 2012

The Fast Demand Response (DR) Pilot Program (Fast DR Program) is a year-round program that offers eligible customers of Hawaiian Electric Company, Inc. and Maui Electric Company, Limited (the Companies) a monthly bill credit for electing to reduce their electricity usage (or demand) in response to requests from the Companies. Fast DR Program Participants are able to determine their individual load shed capabilities by working in coordination with the Companies to design and pre-program their load reduction strategies or Curtailment Schemas in their facility Energy Management System. There are two options for participation in the program: automatic DR (Auto DR) and semi-automated DR (Semi-Auto DR). Participants may only be enrolled in one Participation Option at any given time. All Maui Electric Company, Limited customers shall be enrolled in the Semi-Auto Participation Option.

Participants are expected to comply with the Program Rules for their Participation Option as set forth below. The Program Rules are subject to changes or modifications by either the Hawaii Public Utilities Commission or the Companies.

1. Program Description

1.1. The Fast DR Program terminates December 31, 2013. Prior to termination of the Fast DR Program, the Companies may request approval from the Hawaii Public Utilities Commission (Commission) to extend or otherwise transition Fast DR Program Participants to other available DR programs of the Companies.

1.2. Participation Options.

1.2.1. Automatic DR (Auto-DR): Load curtailment signals are sent to the Participating Facility through a DR Automation Server; signals are received by the Participating Facility via a device installed at the site that initiates the pre-defined routines to reduce demand. This is a "machine-to-machine" process, requiring no human intervention or effort. DR Event notification occurs concurrent with transmission of the signal.

1.2.2. Semi-Auto DR: Participants are notified via phone call, email, or text message that a DR Event is underway. Participants are required to respond by shutting down facility equipment and/or adjusting set points manually or automatically with their facility Energy Management System. Load must be curtailed within 10 minutes of DR Event notification.

1.3. Participant Incentives.

1.3.1. $5.00 per kilowatt (kW) based on Participant’s Nominated Load and performance during each DR Event.

1.3.2. Additional $.50 per kW per hour (kWh) of load curtailed during DR Events (not applicable for first 15 hours of DR Events of each calendar year for each Participant or for events lasting less than 30 minutes.)

1.3.3. Incentives shall be paid in the form of a credit on Participant's bill or at the sole discretion of the Companies in the form of a monthly check.

2. DR Event Hours

2.1. DR Events may be triggered during Program Hours (weekdays Monday- Friday, between 7:00 am and 9:00 pm, excluding state and federal holidays).

3. DR Event Duration

3.1. DR Events shall not exceed:

- 2 hours per DR Event
- 40 DR Events per year
- 80 total DR Event hours per year

4. Penalties for Non-Compliance

4.1. Consistent underperformance by Participating Facilities during DR Events may lead to adjustment of Nominated Load or suspension from the Fast DR Program. Whenever Participant's Monthly Performance Level (see Section 10) falls below 0.80 during two (2) consecutive months, Participant's Nominated Load may be revised to the average kW curtailed during the most recent full calendar month.

4.2. If a Participant does not perform above a 0.50 Event Performance Factor for three (3) consecutive events, the Participant may be suspended from the Fast DR Program for two (2) months. At the discretion of the Companies, Participant may be required to demonstrate its ability to perform at an Event Performance Factor above 0.90 in a Commissioning Load Test subsequent to suspension from the Fast DR Program to be reinstated. Participant will restart Fast DR Program participation with capacity payments calculated at the demonstrated Nominated Load. If required, Participant's Fast DR Program contract shall be modified accordingly to reflect the demonstrated Nominated Load achieved during any required Commissioning Load Test.

4.3. Participant may elect to Opt-Out of the Fast DR Program at any time. If a DR Event is activated while a Participant has Opted-Out, Participant will incur an Opt-Out DR Event. Participant is allowed a total of three (3) Opt-Out DR Events per calendar year. After three (3) Opt-Out DR Events are incurred, any subsequent Opt-Out DR Event shall be included in the Event Performance Factor calculation (see Section 3) where the Event Load Control kW shall be equal to zero.

5. Eligibility

5.1. Customer demand at each Participating Facility must be equal to or greater than 200 kW. Each Participating Facility must provide at least 50 kW of load curtailment per DR Event that would be available between the weekday hours of 7 am and 9 pm. Nominated Loads shall not be aggregated from multiple customer sites.

5.2. Customer must be receiving electric power service under Schedule P or Schedule J.

5.3. Customer must be willing to curtail load immediately (Auto-DR) or within 10-minutes (Semi-auto DR) when requested to do so (activation of DR Event) by Hawaiian Electric or the approved Curtailment Service Provider (CSP).

5.4. Customer and the Companies will collectively consider enablement expenses and cyber and physical security policies to determine the most appropriate Participation Option.

5.5. All Maui Electric Company, Limited customers shall be enrolled in the Semi-Auto Participation Option.

5.6. Participant must be willing to be enrolled for the term of the Fast DR Program Period.

5.7. The condition of the customer's equipment must meet minimum operational and safety standards.

5.8. The Companies reserve the right to make the final determination of the customer's eligibility for participation in the Fast DR Program.

6. Program Operation

6.1. A DR Event may be initiated by the Companies for any reason deemed necessary by the Companies, for example when the electric system may be impaired or operated more efficiently.

6.2. Participant shall curtail load immediately (Auto-DR) or within 10-minutes (Semi-auto DR) when requested to do so (activation of DR Event) by Hawaiian Electric or the approved Curtailment Service Provider (CSP).

6.3. Following a DR Event, load may be restored by Participant only after receiving approval from Hawaiian Electric's system operations or the CSP (for Semi-auto DR). For Auto-DR, the schema programmed in the Participant's Energy Management System will automatically restore to pre-defined normal operating conditions at the conclusion of the DR Event.

6.4. The Companies may periodically conduct tests to verify the Participants' ability to curtail their Nominated Load. Tests shall not exceed two (2) interruptions per year and not more than 30 minutes per test DR Event and will not count against the annual limits or number of events limit. The Event Performance Factor established for the test will be used in calculating a Participant's Monthly Nominated Load Incentives for the month in which the test was conducted.

6.5. If a Participating Facility is not available to participate in DR Events due to facility construction or other activities, Participant shall temporarily withdraw or Opt-Out of DR Events via the Companies' DR Automation Servers (DRAS). If the Opt-Out period exceeds 7 consecutive days, Monthly Nominated Load Incentives shall be pro-rated for the month(s) in which the Opt-Out occurs.

6.6. If a Participant receives a DR Event notification or the DR Event has already begun, Participant may choose to Opt-Out in the first 30 minutes of the DR Event without incurring any adverse consequences, but Participant will incur an Opt-Out DR Event (see Section 4.3).

7. DR Event Notification

7.1. A phone call, email, or text may be sent to Participants' designated facility representatives upon DR Event activation.

7.2. Participant shall designate a primary point of contact to receive program notification and informational updates. Participant shall provide name and phone number or e-mail address for primary point of contact and any other personnel who are designated to receive DR Event notifications. Contact information shall be kept current.

8. Enrollment

8.1. Commissioning Load Test shall occur within 90 days of Fast DR Pilot Program Customer Contract execution, unless otherwise mutually agreed by Participant and Companies.

8.2. Participant agrees to collaborate with the Companies in testing the Load Management Equipment at each Participating Facility in a timely manner. Testing should be completed at least five (5) business days prior to registering the capacity in the Fast DR Program in order to establish a baseline. Participant is not responsible for costs associated with the Companies' collection of real-time data from the participating facility (does not apply to costs associated with submeter installation where necessary).

8.3. If as a result of Commissioning Load Test, Participant's actual load curtailment is less than 90% of Nominated Load, a second Commissioning Load Test may be performed or Participant's Nominated Load may be adjusted to reflect the demonstrated load curtailment. Any additional Commissioning Load Tests shall be performed at Participant's expense.

8.4. The Companies will enable the VirtuWatt™ Demand Response platform for Participant access for those Participants enrolled in Semi-Auto DR. The Companies have the right to deactivate the software following expiration or termination of the Fast DR Program or suspension of the Participant from the Fast DR Program.

8.5. A new Fast DR Program Participant begins with a Monthly Performance Level of 1.00 which is adjusted based on the Participant's Event Performance Factor (see section 10). If Participant's initial first month is less than a full calendar month and no DR Events occur, Monthly Nominated Load Incentives shall be pro-rated for the month.

8.6. Participant will receive Nominated Load and Energy Reduction Incentives at the beginning of the first full billing cycle following the Commissioning Load Test.

9. Load Management Equipment

9.1. The Companies will reimburse a Participant up to $3,000 for fixed costs associated with installing Power Supply, internet connection, and metering infrastructure.

9.2. The Companies, at their option, may install, own and maintain a Revenue Meter (ANSI C12.1) with KYZ pulse outputs and telephone modem capability, as well as an isolation relay and Load Management Equipment, as needed at a Participating Facility.

9.3. The Companies may require Participant to install sub-metering for the purposes of measurement, verification and settlement under, but not limited to the following circumstances, if the curtailable load is a small fraction of the total facility load, the Participant has "co-generation" systems, or metering infrastructure upgrades are cost prohibitive or disruptive to Participant. Participant will be required to install an ANSI C12.1 certified meter or better. The Companies retain the right to verify meter connectivity and confirm that the meter is functioning up to required standards.

9.4. Participant agrees to take delivery and installation by the Companies in a good and workmanlike manner, of all required Load Management Equipment and materials necessary to receive KYZ pulse output from the revenue meter for each Participating Facility. The Companies will own and maintain the Load Management Equipment.

9.5. Participant shall not alter, reverse engineer, disassemble, decompile or copy the Load Management Equipment or any other installed components, and shall not disclose information it receives regarding the Load Management Equipment or any other associated equipment and components to any other person.

9.6. Participant shall allow the Companies to use or examine the Load Management Equipment and any other equipment and components owned and installed by the Companies as necessary for performance and operational verification of the Fast DR Program.

9.7. Participant shall provide a secure location for the Companies' equipment as described herein.

9.8. Participant shall provide a constant 120 VAC power source to within 50 feet of the Load Management Equipment.

9.9. Participant shall provide a dedicated analog telephone line connection to the revenue meter and an Ethernet connection for the Load Management Equipment. Ethernet connection shall consist of a static Internet Protocol address and Local Area Network access that allows for continuous Internet-based communication from each Participating Facility to the Demand Response Automation Server (DRAS) or to the CSP's demand response platform. Participant shall be responsible for the monthly charges for any required communication costs, and for ensuring that the communication lines are in proper working order. Participant shall be responsible for monthly charges to provide required communications to Load Management Equipment.

9.10. Participant, at its own expense, shall supply, install and maintain any protective or switching equipment at Participating Facility that may be required to participate in the Fast DR Program.

10. Fast DR Program Incentive Calculation

Participant shall receive, in the form of a credit on their bill, two forms of incentive payments: the monthly Nominated Load (capacity) Incentive (kW reduction) and the Energy Reduction Incentive (ERI) (kWh reduction) for each DR Event. The ERI is calculated for each event based on the actual energy reduction demonstrated by the Participant.

10.1. Monthly Nominated Load Incentive Calculations

The Monthly Nominated Load Incentive for Fast DR Events is up to $5.00 per kW per month. Monthly Nominated Load Incentives are calculated based on a Participant's performance during DR Events; or in months where no DR Events occur, Monthly Nominated Load Incentives are based on 100% of Nominated Load. The difference between a Participant's DR Event actual energy consumption and Estimated Baseline is the foundation for calculating a Participant's performance. Participant performance is calculated for each DR Event in a given month using the Event Performance Factor methodology (see Section 10.4). The Monthly Nominated Load Incentive will be adjusted based on the Participant's Event Performance Factor during each DR Event.

10.2. Estimated Baseline Calculation

The purpose of the Estimated Baseline is to establish what a Participant's normal energy usage would be based on a Participant's historical energy usage data. The Estimated Baseline kW calculation takes the average demand of the ten (10) previous Similar Usage Days (weekdays, non-holidays, non-event days) using (5) minute interval data for the same time period as the DR

Event. This establishes the average normal demand for the Participating Facility during the DR Event period based on the corresponding interval points from the previous ten (10) Similar Usage Days.

10.3. Adjustment Factor
In order to account for days when a DR Event is triggered for which abnormal energy usage may occur (e.g. higher or lower demand than normal due to weather conditions or other anomalies), the Estimated Baseline is adjusted by using an Adjustment Factor. The Adjustment Factor is based on the difference in Observed Demand (actual usage) and the Estimated Baseline calculated for a Calibration Period of three (3) hours. The three (3) hour Calibration Period is calculated as follows:

Calibration Period = DR Event notice time – four (4) hours to DR Event notice time – one (1) hour

The Adjustment Factor is calculated as the ratio of the Observed Demand to the Estimated Baseline for during the Calibration Period. Adjustment Factor is capped not below .80 and not above 1.2. The Estimated Baseline calculated for the DR Event period is multiplied by the Adjustment Factor which results in the Actual Baseline. The Actual Baseline is used to calculate Nominated Load (capacity) Incentive and the ERI.

10.4. DR Event Performance
Duration of the DR Event will be based upon the Companies' DRAS logs. Observed Demand recorded during the DR Event is subtracted from the Actual Baseline to calculate Event Load Shed in kW.

DR Event performance is then measured as a ratio of Event Load Shed to Nominated Load resulting in each Participant' s Event Performance Factor.

$$\text{Event Performance Factor} = \frac{\text{Event Load Shed (kW)}}{\text{Nominated Load (kW)}}$$

Table 1: Event Performance Factor

Overall Event Performance Level	**Event Performance Factor**
0% to 100%	**0.0 to 1.0 proportional to performance**

From Table 1 above, given a Participant's Event Performance Factor, impact on the Participant's Nominated Load Incentive will be determined and included in the Monthly Nominated Load Incentive calculation.

10.5. Monthly Nominated Load Incentive Calculation
The Event Performance Factor calculated for each event during the month shall be summed and divided by the number of DR Events for the month, as follows:

Monthly Performance Level = $\frac{\text{Sum of Event Performance Factors}}{\text{\# of DR Events}}$

Nominated Load Incentive is $5.00 per kW. Monthly Nominated Load Incentive shall be paid to Participants for each kW of Nominated Load, as specified in Participant's Fast DR Pilot Program Customer Contract and as adjusted by Participant's Monthly Performance Level, as follows.

Monthly Nominated Load Incentive =

Nominated Load (kW) x Monthly Performance Level x Nominated Load Incentive ($$)

If no DR Events are called in a given month, Monthly Performance Level is equal to 1.00.

10.6. Energy Reduction Incentive

Energy savings attained (kWh) during DR Events are rewarded in the form of an Energy Reduction Incentive. Energy Reduction Incentives will be paid starting with the Participant's 16th DR Event hour for each calendar year. Energy Reduction Incentives will not be paid for DR Events lasting 30 minutes or less.

The energy saved or curtailed during a DR Event is calculated by taking the difference between the total energy measured (or consumed) and the Actual Baseline.

DR Event Energy Curtailed = Actual Baseline – Energy Consumed

The Energy Reduction Incentive is $0.50 per kWh.

Energy Reduction Incentive = DR Event Energy Curtailed x Energy Reduction Incentive ($$)