HIGH PERFORMANCE
BEST-PRACTICE KITCHEN MODEL

PRELIMINARY OUTLINE

6 FEBRUARY 2006
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PRELIMINARY OUTLINE
FOR A
HIGH PERFORMANCE
BEST-PRACTICE KITCHEN MODEL
Figure 1: Efficiency Opportunities: Figure 1 shows food service industry energy cost (includes gas and electric energy consumption) by end use. Food preparation and HVAC have the most potential for impact on energy costs (http://www.pge.com/biz/rebates/express_efficiency/useful_info/food_service_guide.html).

I. Introduction: The following pages are a preliminary outline of information that has been compiled to create a high-performance kitchen which optimizes energy and resource use in industrial scale culinary facilities in Hawaii. This document focuses on: minimizing energy, resources and waste, optimizing renewable materials, resource and energy recovery opportunities and identifying best-practice kitchen design and operational practices. This is the preliminary draft outline identifying relevant topics and resources. The research will continue in the effort to create a best-practice culinary demonstration facility for Hawaii.

II. Food Preparation
   A. Water Conservation
      1. Install low-flow water fixtures throughout kitchen—resulted in a water savings of approximately 30%, or 3,000 gallons/day (Lum)
         a. Use a waterless urinal
            i. Saves 1 gallon per flush (Lum)
            ii. Durable, little maintenance and odor free (Lum)
         b. Use electronic, sensor-operated faucets in all restrooms
            i. Saves 2 gallons per minute (Lum)
         c. Install faucet aerators on kitchen sinks (www.aps.com)
            i. Saves 0.3 gallons per minute (Lum)
            ii. Provides quality water stream for kitchen use (Lum&www.aps.com)

   B. Hot Water Production and Use
      1. Use a heat recovery device (Energy Concept Advisor & PGE).
         a. Food refrigeration when there is a central production system is a heat source for pre-heating hot water. It benefits both to the water production and the refrigeration system because its coefficient of performance is improved when rejected heat is evacuated at a constant low temperature. (Energy Concept Advisor)
            i. Install a refrigerant heat recovery system and use the waste heat from the walk-in refrigerator and freezer to preheat the facility hot water 1% (www.pge.com).
Table 1. Waste-heat recovery devices and applications

<table>
<thead>
<tr>
<th>Heat Recovery Device</th>
<th>Temperature Range</th>
<th>Typical Sources</th>
<th>Typical Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation Recuperator</td>
<td>High</td>
<td>Incinerator or boiler exhaust</td>
<td>Combustion air preheat</td>
</tr>
<tr>
<td>Convective Recuperator</td>
<td>Medium-High</td>
<td>Soaking or annealing ovens, melting furnaces, afterburners, gas incinerators, radiant-tube burners, reheat furnaces</td>
<td>Combustion air preheat</td>
</tr>
<tr>
<td>Furnace Regenerator</td>
<td>High</td>
<td>Glass and steel-melting furnaces</td>
<td>Combustion air preheat</td>
</tr>
<tr>
<td>Metallic Heat Wheel</td>
<td>Low- Medium</td>
<td>Curing and drying ovens, boiler exhaust</td>
<td>Combustion air preheat, space heat</td>
</tr>
<tr>
<td>Hygroscopic Heat Wheel</td>
<td>Low</td>
<td>Curing and drying ovens</td>
<td>Combustion air preheat, space heat</td>
</tr>
<tr>
<td>Ceramic Heat Wheel</td>
<td>Medium-High</td>
<td>Large boiler or incinerator exhaust</td>
<td>Combustion air preheat</td>
</tr>
<tr>
<td>Passive Regenerator</td>
<td>Low-High</td>
<td>Drying, curing &amp; baking ovens, exhaust from boilers, incinerators &amp; turbines</td>
<td>Combustion air preheat, space heat</td>
</tr>
<tr>
<td>Finned-Tube Regenerator</td>
<td>Low-Medium</td>
<td>Boiler exhaust</td>
<td>Boiler make-up water preheat</td>
</tr>
<tr>
<td>Shell &amp; Tube Regenerator</td>
<td>Low</td>
<td>Refrigeration condensates, waste steam, distillation condensates, coolant from engines, air compressors, bearing &amp; lubricants</td>
<td>Liquid feed flows requiring heating</td>
</tr>
<tr>
<td>Heat Pipes</td>
<td>Low-Medium</td>
<td>Drying, curing &amp; baking ovens, waste steam, air dryers, kilns (secondary recovery), reverberatory furnaces (secondary recovery)</td>
<td>Combustion air preheat, boiler makeup water preheat, steam generation, domestic hot water, space heat</td>
</tr>
<tr>
<td>Waste Heat Boiler</td>
<td>Medium-High</td>
<td>Exhaust from gas turbines, reciprocating engines incinerators, furnaces</td>
<td>Hot water or steam generation</td>
</tr>
<tr>
<td>Gas/Steam Turbines</td>
<td>Medium-High</td>
<td>High-pressure steam reduced for low-pressure application, waste steam</td>
<td>Generation of electrical or mechanical power</td>
</tr>
</tbody>
</table>

(www.pge.com)

2. Solar collector/power 50-60% (Energy Concept Advisor)
3. Insulation of the piping network 2-5% (Energy Concept Advisor)
4. Installation of hot water automatic tap 20-50% (Energy Concept Advisor)
   a. Automatic taps replace traditional taps in a rather easy way and contribute reducing water consumption and thus the need to heat water (Energy Concept Advisor)
5. Insulation of the hot water storage tank 5-10% (Energy Concept Advisor)
6. Optimization of temperature setback 5-10% (Energy Concept Advisor)
C. Forced Convention Ovens, Cooktop Ovens, Warmers, Microwaves, Grills, Deep-fryers

Table 2. Efficiency of Ovens

<table>
<thead>
<tr>
<th>Cooking Method</th>
<th>Cooking Efficiency (%)</th>
<th>Energy Factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave</td>
<td>57.5</td>
<td>57.5</td>
</tr>
<tr>
<td>Electric, self cleaning, convection</td>
<td>17.1</td>
<td>13.4</td>
</tr>
<tr>
<td>Electric, self cleaning</td>
<td>13.9</td>
<td>10.2</td>
</tr>
<tr>
<td>Electric, standard</td>
<td>12.1</td>
<td>10.9</td>
</tr>
<tr>
<td>Gas, electric ignition, self cleaning, convection</td>
<td>8.7</td>
<td>7.4</td>
</tr>
<tr>
<td>Gas, electric ignition, self cleaning</td>
<td>7.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Gas, electric ignition</td>
<td>6.1</td>
<td>5.8</td>
</tr>
<tr>
<td>Gas, pilot light</td>
<td>5.9</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Notes: Cooking efficiency is the fraction of the energy supplied to the unit that heats food during a typical cooking cycle. Energy factor is the ratio of energy that is effectively used to heat food to the total energy used (www.aps.com)

Table 3. Relative Cost of Operation for Ovens

<table>
<thead>
<tr>
<th>Cooking Method</th>
<th>Relative Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave</td>
<td>1</td>
</tr>
<tr>
<td>Electric, self cleaning, convection</td>
<td>3.4</td>
</tr>
<tr>
<td>Electric, self cleaning</td>
<td>4.1</td>
</tr>
<tr>
<td>Electric, standard</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Note: Costs are in terms of how much electricity an oven would use for a task relative to a microwave oven. For instance, if it costs $0.10 to cook an item in a microwave, it would cost approximately $0.48 in a standard electric oven (www.aps.com)

1. Forced convection ovens
   a. Preferred to natural convection ovens.
   b. Convection ovens are 23% more efficient than conventional ovens (www.aps.com)
      i. In forced convection ovens, an air turbine is used to homogenize temperature and heat transmission within the enclosure. As a result the efficiency is improved from 45% for a static oven to 80% in a forced convection. Additionally the heating up period is shorter which results in a global saving of 45%
   c. Using ceramic or glass pans will allow food to cook at an oven temperature 25 degrees fahrenheit lower than would be needed for metal pans. (www.aps.com)
2. Microwave ovens (www.aps.com)
   a. Most efficient, fastest and lowest cost
      i. Heat only the food
   b. Operate more effectively if inside is kept clean
3. Flashbake® ovens (www.aps.com)
   a. Use a combination of intense visible light from halogen bulbs and infrared energy to cook food. It produces the browning effect of conventional ovens, but cooks almost twice as fast.
   b. Only operate when cooking is taking place—not necessary to leave these oven on during non-cooking times to maintain oven temperature
4. Induction Stovetops
   a. Advantages over conventional stovetops including efficiency, controllability and safety. It heats the pan by creating a strong magnetic field, which in turn induces a current in any magnetic pan. The current causes the pan to heat and cook the food. The stovetop stays relatively cool and it is nearly impossible to start a fire by leaving the burner on. No special cookware required.

b. Stovetop Energy Saving Opportunities (www.aps.com)
   i. Use pressure cookers
      a. Uses higher temperatures, allows the cooking to be completed faster, which reduces energy costs by about two thirds.
   ii. Use flat-bottomed cookware on electric elements and closed-top cooktops
      a. Contact between cookware and cooktop equals higher efficiency, only using about two thirds the energy as a warped piece of cookware
   iii. Use equipment that fits the burner
      a. Pots and pans should be one inch in diameter than the burner they are on—important for efficiency, speed and less energy use
   iv. Use lids
      a. Increases efficiency by 8-14%

5. Fryer Energy Saving Opportunities
   a. Limit fryer preheat times
      i. Preheat no longer than manufacturers instructions—between 7-15 minutes—any longer only wastes energy (www.aps.com)
   b. Remove sediment
      i. When sediment accumulates, the energy efficiency of the fryer is reduced (www.aps.com)
   c. Clean the heating element
      i. same as above, 5b.
   d. Check temperatures

6. Broiler Energy Saving Opportunities—eliminating 1 hour per day of broiler idle can save $200 annually (www.pge.com).
   a. Minimize preheat time (www.aps.com)
   b. Keep them full (www.aps.com)
   c. Use infrared broilers (www.aps.com)
      i. No preheat time required, but remember to turn them off between loads (www.aps.com)

7. Purchase energy efficient appliances such as insulated hot food holding cabinets, coffee makers with automatic shutoff features, insulated electric fryers, induction cooktops, connectionless steamers, and insulated dishwashers 3% (www.pge.com).

8. Other kitchen energy saving ideas
   b. Keep stovetops, ovens, fryers, broilers and griddles clean (www.aps.com).
   c. Use the appropriate size of appliance for the task (www.aps.com).
   d. Turn off electric burner several minutes before the allotted cooking time (www.aps.com).
   e. Use a timer (www.aps.com).

III. Ventilation HVAC (PGE)
   A. Utilize an absorption chiller rather than traditional vapor compression chiller (Lum)
      1. Contains no ozone-depleting substance and requires only a heat source to operate (Lum)
         a. Use solar panels to provide the heat for the absorption system (Lum)
   B. see Improving Kitchen Ventilation Performance
C. Air Conditioning and Industrial Cooling with Common Heritage Corporation (CHC) based in the State of Hawaii.
   1. CHC uses new technology called, DOW (Deep Ocean Water) cooling, to cool residential and industrial buildings. CHC technology utilizes the cold properties of DOW maintaining it is reliable, environmentally sustainable, and can reduce cooling costs by more than 90 percent when compared to conventional systems (www.commonheritagecorp.com).

D. Install Energy Star labeled programmable thermostat 2% (www.pge.com).

E. Schedule preventative maintenance ½-1% (www.pge.com); 5% (Energy Concept Advisor)
   1. Cleaning dirty refrigeration coils can save 25% in operating costs and help to prevent early compressor failure (www.pge.com).
   2. Replace HVAC filters at least once every quarter 0.2% (www.pge.com)

F. Specify optimized UL listed kitchen exhaust hoods, including variable speed exhaust fan controls 4% (www.pge.com).

G. Install advance glazing systems 3% (www.pge.com); 7% (Energy Concept Advisor)

H. Very effective: Well placed trees, awnings or other shading devices 3% (www.pge.com).

I. Turn off exhaust hood when the appliance below are turned off 1% (www.pge.com).

J. Use recommended thermostat set points; unoccupied or night set-back thermostat settings when facility is closed and turn off the HVAC fans at night 2% (www.pge.com).

K. Whenever possible replace manual control or simple control timers with air quality detection sensors coupled with electronic times and ceiling fans (Energy Concept Advisor).

L. Make sure that HVAC economizers are working properly and are set to maximize “free cooling” 1% (www.pge.com).

M. Specify optimized UL listed kitchen exhaust hoods, including variable speed exhaust fan controls 4% (www.pge.com).

N. UV Purification

IV. Sanitation
   A. Plumbing
      1. Low-flush toilets
      2. Sewage Treatment
            i. Locally owned and based
            ii. Treated with microorganisms to eat away waste—resulting wastewater can be used to irrigate crops and won’t hurt groundwater

   B. Waste Management
      1. Grease Traps
         a. Grease Trap maintenance with Environmental Biotech Consultants
            i. Environmental Biotech Consultants maintain grease traps with “friendly bacteria.” Once grease trap capacity reaches 25%, they pump trap and take all grease to Pacific Biodiesel.
         b. Transforming cooking oil from grease traps
            i. Bio-Diesel (Kawahara)
               aa. Pacific Biodiesel Inc. #(808) 841-2177, turns grease trap cooking oil into both biodiesel fuel that runs in any diesel engine, and low-boiler fuel.
               ii. Low-boiler fuel
                  aa. Island Commodities Corporation #(808) 682-5844 uses cooking oil to create low-boiler fuel.
      2. Recycle
         a. Have separate garbage cans in strategic locations
            i. glass, aluminum and plastic together
            ii. newspaper and corrugated cardboard together
            iii. white paper separated
            iv. colored paper separated
         b. Have a place to put all the recycling outside—request a recycling bin from the state.
3. Food Waste
   a. Compost
      i. Keep a garbage can specifically for food scraps next to the dishwasher, in the kitchen and (if applicable) at a server station
      ii. Create a compost pile outside
   b. Animal Food
      i. Ecofeed, Honolulu # (808) 841-5586, turns food waste into animal food
      ii. Pig slop
         aa. Pig Farmers, University of Hawaii Swine Extension specialist at # (808) 956-7594—strict regulations for farmers, semi-competitive because farmers can choose from hotel and restaurant industry within Waikiki/ the highest bidder.
   c. Quality Food Waste
      i. Aloha Harvest, Honolulu, # (808) 537-6945, takes quality food waste donations and uses the donations to feed people by delivering to non-profits.
   d. Meat Scraps
      i. Island Commodities Corporation # (808) 682-5844 picks up meat scraps to create plant fertilizer

4. Educate your employees! Make sure they know the proper materials to recycle, which bins to separate and store materials, and where to throw the recycling when full.

C. Waste Water
   1. Gray water Recycling (Lum)
      a. “Gray water is untreated wastewater from showers, bathroom lavatories and washing machines. It does not include wastewater from toilets, dishwashers, kitchen sinks or other water sources with food contamination” (Lum).
      i. Gray water systems have: drain-line plumbing, surge tank and a associated equipment and the delivery system. “Additional plumbing works is required to separate gray water from other waste water and divert it to a common channel that leads to the surge tank” (Lum).
   2. On-site waste water treatment
      a. Use constructed wetlands to treat wastewater in a sustainable, low-impact manner (Lum)
      i. No energy used for treatment (Lum)
      ii. Minimal sludge generation (Lum)
      iii. Inexpensive to build, low operation and maintenance costs (Lum)
      iv. Attractive foliage, layout, and ability to incorporate indigenous plants (Lum)
      v. Lack of odor (in a subsurface application) (Lum)
      vi. Wildlife habitat creation (Lum)

D. Dish Washing
      a. A low-flow pre-rinse spray valve is one of the easiest and most cost effective energy saving devices available to the foodservice operator. In addition to minimizing water consumption, water heating energy and sewer charges are also reduced. Replacing a typical spray valve that flows up to three gallons of water per minute (gpm) with a low-flow unit can yield the following results:
Table 4.

<table>
<thead>
<tr>
<th>Hours of Spray Valve Usage</th>
<th>Water Savings glasses/day</th>
<th>Waste Water Savings glasses/day</th>
<th>Gas Savings therms/day</th>
<th>Annual Dollar Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour/day</td>
<td>60 gallons</td>
<td>60 gallons</td>
<td>0.5 therms</td>
<td>$400 - $450</td>
</tr>
<tr>
<td>2 hours/day</td>
<td>120 gallons</td>
<td>120 gallons</td>
<td>1.0 therms</td>
<td>$800 - $900</td>
</tr>
<tr>
<td>3 hours/day</td>
<td>180 gallons</td>
<td>180 gallons</td>
<td>1.5 therms</td>
<td>$1200 - $1350</td>
</tr>
</tbody>
</table>

Table shows results based on spray valve water savings of 1 gallon per minute, water cost of $2.00 per unit (748 gallons), sewer cost of 3.00 per unit (748 gallons), and gas cost of $1.60 per therm. (http://www.fishnick.com/saveenergy/sprayvalves/)

b. The FSTC recommends a pre-rinse spray valve with a flow rate of 1.6 gallons per minute or less, and with a “cleanability performance” of 26 seconds per plate or less, based on the ASTM Standard Test Method for Performance of Pre-Rinse Spray Valves.

2. Use cold water to operate a food disposer (www.aps.com)
   a. This saves water heating energy and helps get rid of grease—grease solidifies in cold water and gets ground up and washed away.

E. Dish Washer
   1. Fill dishwasher racks to capacity with each load. This can save $200 annually (www.pge.com).
   2. Reduce dishwasher usage- fully load the dishwasher, maintain the elements, and turn off the tank and booster heaters when the facility is closed 1% (www.pge.com).

F. Laundry
   1. Use Energy Star equipment (www.energystar.gov)
      a. Provide precise control of water temperature and cycles
   3. Monitor general use
      a. Laundry water temperatures should be reduced to 160 degrees Fahrenheit (www.energystar.gov)
      b. Use soap and detergent that performs at even lower temperatures (www.energystar.gov)
      c. Always operate with a full load (www.energystar.gov).

V. Lighting
   A. Construct building to utilize maximum amount of natural light
      1. Use sidelighting with the use of light shelves (Lum)
   B. Use T8 lams and electronic ballasts 2% (www.pge.com).
   C. Install electronic controllable ballasts to facilitate daylight harvesting 2% (www.pge.com).
   D. Install LED “Exit” signs 2% (www.pge.com).
   E. Install occupancy sensors in non-essential lighting areas 0.2% (www.pge.com).
   F. Install timed switches and/or low-temperature occupancy sensors in walk-in coolers and freezers 6% + (www.pge.com).
   G. Reduce the wattage of interior lamps and decorative lighting 1.0% (www.pge.com).
   H. Retrofit parking lot lights with lower wattage lamps 30% (www.pge.com).
   I. Delamp—reduce the number of lamps or turn lights off when there is adequate light especially in daylit areas adjacent to windows 1% (www.pge.com).
   J. Reduce the wattage of interior lamps and decorative lighting 10% (www.pge.com).
   K. Use natural daylight and turn lights off 2-10% (www.pge.com).
      1. Create skylights/openings in walls or roofs, combined with appropriate shutters, blinds or awnings can help reduce drastically electric consumption for lighting if combined with either of the above mentioned controls (Energy Concept Advisor)
   L. Install electronic dimmable ballasts and lighting controls to dim lights when daylight is available 20%+ (www.pge.com).
   M. Install compact fluorescent lamps in place of incandescent bulbs where possible—e.g. in exhaust hoods, storerooms, break rooms, walk-in refrigerators, and offices 1% (www.pge.com).
VI. Energy Source Alternative
   A. DOW-REST™ (Deep Ocean Water- Renewable Energy System) with Common Heritage Corporation (CHC).
      1. DOW Renewable Energy System (DOW-REST™) provides environmentally friendly, continuous electrical power using CHC’s renewable energy technologies to create a sustainable habitat based on renewable energies generated on-site (www.commonheritagecorp.com).

VII. Refrigerators, Freezers, and Ice Makers
   A. Refrigerators & Freezers
      1. Purchase Energy Star products (www.energystar.gov)
      2. Overall maintenance and better insulation (Energy Concept Advisor)
         a. Insulate outdoor refrigerant lines, especially rooftop lines 0.2% (www.pge.com).
         b. Replacing damaged door gaskets can save $100 annually (www.pge.com)
         c. Cleaning dirty refrigeration coils can save 25% in operation cost and helps prevent early compressor failure (www.pge.com).
         d. Clean clogged and dirty condenser and evaporator coils at least once every quarter 0.3% (www.pge.com).
      3. Use heat recovery from food refrigeration for water heating (Energy Concept Advisor, Industrial Heat-Recovery Strategies)
      4. Reduce space cooling load (Energy Concept Advisor)
         a. split equipment
         b. place rear part of the refrigerator outside using wall cut-out
      5. Check the defrost time clock- make sure it is set properly. Do not defrost more often than necessary. Do not defrost while adding the refrigerator or freezer 0.5% (www.pge.com).

   B. Ice Makers
      1. Water-Cooled vs. Air-Cooled
         a. Generally water-cooled are more efficient than air-cooled, but…
         b. Water-cooled use drinking water—up to 15-45 gallons/100lbs ice
         c. Air-cooled can be as efficient as: 5.4kWh/ 100 lbs ice; 5,400kWh annual energy use; $320 annual energy costs, $1,850 lifetime energy cost; $900 lifetime energy savings (all FEMP)

VIII. Industrial Kitchen Planning
   A. Design
      1. Install an energy management system to control the building’s energy using systems including lighting, kitchen exhaust, refrigeration, and HVAC 4% (www.pge.com).
   B. Layout
   C. Routines

IX. Floors
   A. Floor Types – (http://www.findarticles.com/p/articles/mi_m0FKA/is_3_66/ai_113337715)
      1. Linoleum or Marmoleum. Made of pine rosins, wood flour and linseed oil with a jute fiber backing, Marmoleum, is touted as biodegradable, allergen-free, bacteria-resistant and easy to clean.
      2. Kirei USA 1805 Newton Ave. San Diego, CA 92101 #(619) 236-9924 www.kireiusa.com Manufacured from the raw stalks of sorghum, a grass grown around the world for food. After the harvest of the edible portion of the plant, the stalks are compressed, washed, and woven into sheets. These sheets are then stacked and heat-pressed with a formaldehyde-free adhesive to create blocks which are cut to the desired size.
      3. Cork Flooring. Easy to clean. What's left from making wine corks is ground up and used in sheets of flooring.
4. Bamboo. The bamboo plant grows quickly, making it a highly sustainable crop.
   a. Minimum of 60 months old
   b. Needs to be a full 5/8” think (not 9/16”)
   c. Employs European made glues and finishes—it is probably best to buy from factories which supply the European countries from a source that mentions their price last. (Bamboo that sells for under $5.00 a square foot in the USA just cannot be durable, well made, nor have a uniform quality look, or be very safe.) <www.igreenbuild.com>

5. Clay-based saltillo tiles, ceramic tiles and stone—all of which are durable and do not outgas—are also good options

6. NO Vinyl – outgasses chemicals, and when burned, such as in a landfills, those chemicals become deadly toxins.

B. Floor Finishing Alternatives: (http://www.edcmag.com/CDA/ArticleInformation/features/BNP__Features__Item/0,4120,162010,00.html)
   1. Make sure the manufacturer lists all the ingredients in the products.
   2. Select products that do not contain carcinogens, reproductive toxins, zinc, or heavy metals.
   3. Make sure VOC concentration is under 7 percent at use dilution.
   4. Along with the chemicals mentioned earlier, make sure the products do not contain alkylphenol ethoxylates/NPEs.
   5. Select products with a pH no higher than 11.5.

X. Counter Tops:
   A. Origins, a nontoxic product by the Missouri firm of Yemm & Hart is made entirely from recycled milk and detergent bottles (http://www.findarticles.com/p/articles/mi_m0FKA/is_3_66/ai_113337715)

XI. Cabinet Options:
   A. Wheatboard—chopped tip wheal straw and glued together with a better glue that does not outgas (http://www.findarticles.com/p/articles/mi_m0FKA/is_3_66/ai_113337715)

XII. Behavioral Techniques
   A. Habit/Employee Training—behavioral improvement of staff saves 10- 50% (Energy Concept Advisor).
      1. Teach your employees the importance of energy conservation and how to conserve daily in everyday use, e.g. the importance of equipment maintenance, proper use of equipment, light, water and waste conservation, recycling, etc.
         a. Turn off lights in unoccupied areas e.g walk-in refrigerators, storage and break rooms 2-5% (www.pge.com)
      2. Identifying when each appliance is first used, and turning it on then can save up to $1000 per year (www.pge.com).
      3. Implement a daily “start-up” and “shut-down” schedule for cooking appliances. Pay the most attention to the biggest energy users like the broiler, griddle, range top, pasta cooker, rotisserie, conveyer oven, and fryer. Turn off “back-up” appliances when they are not needed 2% (www.pge.com).
XIII. Building Orientation

A. Minimize east and west-facing windows (Lum).
   1. Elongate the building plan along an east-west axis, reducing windows on the east and west or even reserving these areas for service spaces is encouraged to minimize unwanted direct sun (Lum).

B. Design interior layout to match program needs and daylight availability (Lum).
   1. Arrange floor plan to allow spaces that require more daylight to be in locations of greater availability (Lum).

C. Design floor plans to allow daylight penetration (Lum).
   1. Understand and utilize proper light and space proportions since “the ability of daylight to provide adequate illumination to a space depends largely on its proportion and size” (Lum).

XIV. Conclusion: This preliminary outline reveals the food preparation and HVAC sectors of the industrial kitchen allow the most potential for energy conservation. Water and energy savings are available through a wide range of design and operational choices. By implementing behavioral energy conservation techniques—such as turning off unnecessary appliances and lights—dramatic energy and economic savings are gained without sacrificing quality or efficiency of product.

Creating a best-practice culinary demonstration facility illustrates the multitude of possibilities for energy conservation within industrial kitchens. Creating a best-practice culinary model facility that incorporates these opportunities would effectively demonstrate energy, water and cost savings strategies to the Hotel, Restaurant and Tourism industry on the large scale as well as similar measures and behaviors beneficial for the residential and personal scale.
Resources


Common Heritage Corporation. 1001 Bishop St., 19th Floor, ASB Tower, Honolulu, Hawai'i 96813-3649 Email: <info@commonheritagecorp.com>. Telephone: (808) 544-3066 Fax: (808) 356-0124 <www.commonheritagecorp.com>.


Environmental Biotech of Hawaii. 549 Halemaumau Street Suite C2, Honolulu, HI 96821 Phone: (808) 373-7780 <www.environmentalbiotech.com> (7 February 2006).


Ecofeed, Honolulu, Hawaii 96817, Phone (808) 537-6945

Island Commodities, 91-296 Olai, Honolulu, Hawaii, Phone (808) 682-5844

Aloha Harvest, 560 N. Nimitz Hwy, Honolulu, Hawaii 96817, Phone (808) 537-6945

Pig Farmers, University of Hawaii Swine Extension specialist at Phone (808) 956-7594

Hager, Steve, President, George M. Matsumoto & Associates, 3536 Harding Ave., Honolulu, Hawaii 96816-2453, Phone 735-6433 [Design Firm]

Island Commodities Corporation. 91-2689 Olai, Honolulu, HI 96813 Phone: (808) 682-5844

Kawahara, Ken. Department of Environmental Services, City and County of Honolulu. Phone: (808) 692 5377 Email : kkawahara@honolulu.gov Telephone conversation. 16 December 2005.


Mizo, Irvin, Mizo and Associates Inc., 408 N. Kuakini Apt 1, Honolulu, HI. 96817-2311, Phone 526-1774 [Design Firm]


Pacific Biodiesel Inc. 1003 Makepono Street, Honolulu, HI 96819 Phone: (808) 841-2177 <www.biodiesel.com> (15 December 2005).

“Proposed Amendment to Canada’s Energy Efficiency Regulations; Self-contained, Commercial


