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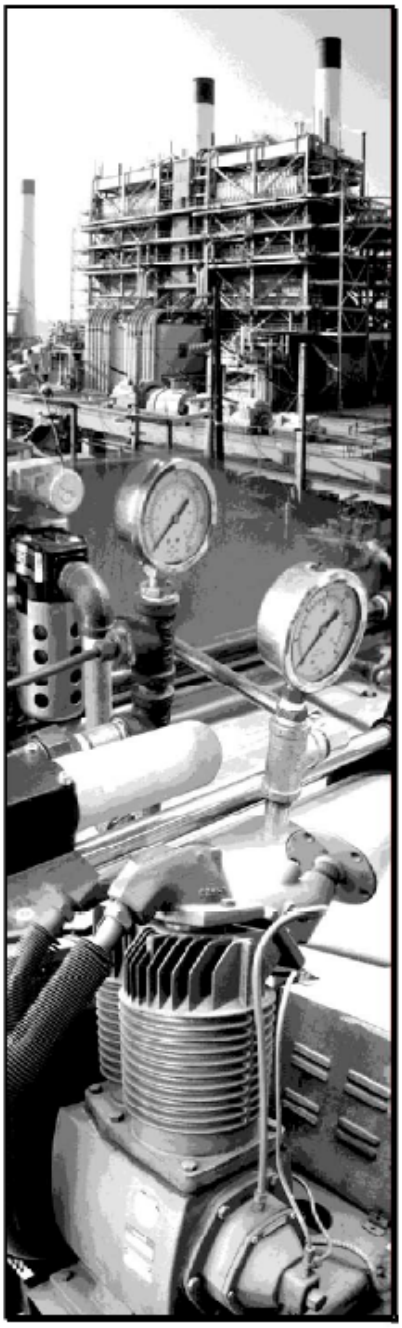

California's Food Processing Industry Energy Efficiency Initiative:

Adoption of Industrial Best Practices

STAFF REPORT

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CALIFORNIA ENERGY COMMISSION

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ABSTRACT

In partnership with the California League of Food Processors, the California Energy Commission encourages the adoption of industrial Best Practices to advance energy efficiency in the food processing industry. The partnership works with investor and publicly owned utilities to hold training workshops and support the delivery of energy system assessments to their customers. These services encourage company managers to establish a corporate commitment to energy efficiency. The adoption of Best Practices can generate significant energy savings resulting in considerable cost savings to California's $50 billion food processing industry.

KEYWORDS

Energy efficiency, best practices, food industry, food processing, California Energy Commission, California League of Food Processors, training workshops, energy systems assessments, steam systems, compressed air system, case studies.

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CHAPTER 1: Food Industry Energy Efficiency Initiative

Industry Background and Initiative Goals

California's food processing industry generates over $50 billion in gross annual revenues, consuming more than 600 million therms of natural gas and over 3,700 million kilowatt hour, including the electricity used in refrigerated warehouses. Food processing is the third largest industrial energy user in the state.

This report documents the efforts conducted and the achievements to date of the California Food Industry Energy Efficiency Initiative (Initiative). The Initiative is rooted in the efforts of the California Energy Commission's (Energy Commission) Process Energy Group in partnership with the California League of Food Processors (CLFP), the state's investor owned utilities (IOUs) and Publicly Owned Utilities (POUs).

The Initiative promotes corporate commitment to energy efficiency through the products and services offered by the Energy Commission, the Public Goods Charge (PGC) programs administered by the IOUs and independent efficiency programs sponsored by the POUs. The CLFP encourages food processing companies to actively participate in efficiency programs and take advantage of these services to obtain a return on their contribution to the PGC funds.

For the purposes of this document: Industrial Best Practices (BP) refers to the products and services developed by the United States Department of Energy (DOE), Office of Industrial Technologies. Energy efficiency includes all activities related to the adoption of energy-efficiency technologies and best management practices, such as demand reduction through conservation, productivity improvements, peak load reduction and shifting, heat recovery and energy production. The food processing industry refers to all activities that transform food and fiber crop production into storable products.

For more details on BP, please visit:
http://www1.eere.energy.gov/industry/bestpractices/.

CHAPTER 2: Outreach Activities: Training and Technical Assistance

The Energy Commission's Process Energy Group works closely with plant managers, executives and industry representatives to continuously understand the needs of the food processing industry. Program offerings are tailored to address the energy interests of the industry through the following efforts:

- Funding of research, development, and demonstration projects
- Delivery of education and training workshops
- Providing on-site energy system assessments
- Providing low-cost financing for energy efficient emerging technologies

The Initiative's highest priority is to advance an understanding of efficiency technologies among plant personnel who will transfer this knowledge into best practices at their company. To achieve this goal, the Energy Commission sponsors education and training BP workshops and conducts on-site energy system assessments (ESAs).

These products are designed to promote energy efficiency practices to decision makers and system operators. Learning BP's through workshops provides workers with the tools to identify system inefficiencies. BP's also offer basic "rules of thumb" to help operators calculate system efficiencies and adopt practical energy management practices to improve productivity.

The ESA's offer a "snap shot" of system performance with recommendations to address short-term, low cost measures. The ESA also identifies medium to long term opportunities that increase system efficiencies and achieve cost reductions.

The Initiative encourages companies that schedule ESA's to send plant personnel to attend BP workshops and then participate in the ESA at their facility. Using this approach enhances plant personnel's ability to practice the BP theory in their own facilities. The combined effect of learning by doing should lead to sustained energy efficiency practices by experienced energy system operators.

Since 2004, the Energy Commission has, with grants from the DOE, offered these products and services to meet industry needs. The outreach activities are only possible through cooperation with key industry and utility partners. The Initiative partners include, the California League of Food Processors, Pacific Gas and Electric, Sacramento Municipal Utility District, Southern California Edison, Southern California Gas Company, Sempra Energy Utility and Modesto Irrigation District. The Initiative also enhances opportunities for utility partners to promote the products and services they offer through their energy efficiency and conservation programs.

CHAPTER 3: Industrial Best Practices Training Workshops

Industrial BP training workshops are offered throughout the state during the fall, winter and spring seasons. The workshops are led by DOE Qualified Instructors, using DOE-developed training materials and software analysis tools.

As of the Fall of 2007, more than 80 Industrial BP workshops have been hosted by California utility partners. The workshops have been attended by nearly 1,500 industrialists and others involved in industrial process energy efficiency. For the 2008-10 DOE funding cycle, the Energy Commission's goal is to sponsor 40 new BP workshops.

Post-workshop survey results indicate that 60 percent of BP workshop attendants become more interested in testing and adopting best management practices to improve energy efficiency in their facilities.

For an up-to-date BP workshops scheduled in California, please visit: http://energy.ca.gov/process/index.html. *The following page provides detailed information about the technical characteristics of the BP subject areas.*

CHAPTER 4: Technical Characteristics of BP Workshops

Fundamentals of Compressed Air Systems and Advanced Management Compressed Air Systems Level 2

Many industries use compressed air systems as power sources for tools and equipment. This initial class demonstrates how to compute the current cost of your plant's compressed air systems, measure and create a baseline of system performance, and determine the impact of different compressor control types. Learn how to achieve cost savings through more effective production and use of compressed air. *For complete course information:* *http://www.eere.energy.gov/industry/bestpractices/training_compressed_air.html.*

Fan Systems Assessment

This one-day workshop highlights the benefits of optimizing fan performance to reduce costs. It introduces use of the Fan System Assessment Tool (FSAT) software, where users can: determine system efficiency, identify degraded fans, collect data for trending system operation, and quantify potential cost and energy savings. *For complete course information:* *http://www.eere.energy.gov/industry/bestpractices/fan_systems.html.*

Motor Systems Management

Motor Systems Management training is designed to help facility personnel reduce energy costs and increase the reliability of their systems. This one day workshop covers inventory tracking, maintenance, repair, power quality, management of power transmission and driven loads as they relate to motor operation. Learn the basics of MotorMaster+ software tool to evaluate motor performance and repair. *For complete course information:* *http://www.eere.energy.gov/industry/bestpractices/motor_systems.html.*

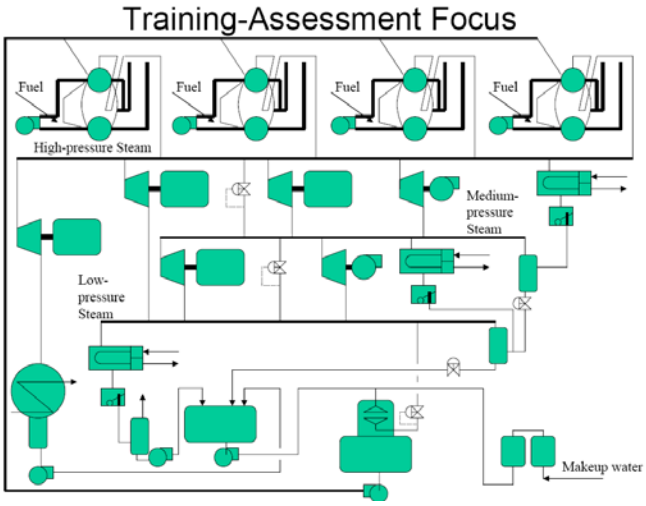
Process Heating Assessment

Advanced technologies and operating practices offer significant savings opportunities in process heating, with the potential to reduce energy consumption an additional 5 to 25 percent in the next decade. This one-day workshop includes an introduction to process heating and the equipment used by the industry, discussions of combustion, heat transfer in furnaces, waste heat recovery. Also, students will be instructed in the use of the Process Heating Assessment and Survey Tool (PHAST) software.
For complete course information:
http://www.eere.energy.gov/industry/bestpractices/training_process_heating.html.

Pumping Systems Assessment

This one-day workshop covers practical issues involved in field measurements of fluid and electrical data. It offers an introduction to the Pumping System Assessment Tool (PSAT) software which is used to assess the performance of pump systems. Learn how the software functions, what data is required, how to use the software when measured data are not available, and what the assessment results mean. *For complete course information:*
http://www.eere.energy.gov/industry/bestpractices/pumping_systems.html.

Steam Systems Assessment



Many facilities can save energy through the installation of more efficient steam equipment. This one-day course covers methods of system efficiency and operation of typical steam systems. The workshop covers material in steam generation efficiency, steam distribution system losses, and resource effectiveness. *For complete course information:*
http://www.eere.energy.gov/industry/bestpractices/steam_systems.html.

CHAPTER 5: Energy System Assessments

The Energy Commission offers Energy System Assessments (ESAs) to food processing facilities to evaluate steam, process heat, and compressed air systems, motors, pumps and fans. The ESAs use DOE certified system analysis methodologies and software tools to identify energy efficiency opportunities. The ESA provides a "snap shot" of system efficiencies; possible no/low cost, short term savings opportunities, and medium to longer term capital improvements.

For additional examples of ESA benefits, please follow to page 12.

CHAPTER 6: Food Processing Plant Assessment Summary 2005-2007

INDUSTRIAL ENERGY EFFICIENCY PROGRAM

FOOD PROCESSING PLANT ASSESSMENT SUMMARY 2005-2007

CALIFORNIA ENERGY COMMISSION

IDENTIFIED EARLY SAVINGS

- **Natural Gas: 13 million therms**
- **Energy Costs: $3.8 million**
- **Electricity: 6 million kWh**
- **CO2: 22,000 tons**

COMPLETED ASSESSMENTS

PLANT	NUMBER	TYPE
Cheese Processing	2	Steam
Meat Packing	2	Steam; Refrigeration
Fruit Canning	1	Compressed Air
Juice Bottling	1	Steam
Noodle Products	1	Steam
Olive Processing	1	Steam
Beer Brewing	1	Steam, Refrigeration, Cogeneration

ASSESSMENTS UNDERWAY OR SCHEDULED

PLANT	NUMBER	TYPE
Tomato Processing	2	Compressed Air, Steam
Snack Foods	1	Compressed Air
Raisin Processing	1	Steam
Dairy Processing	1	Steam

December 7, 2007

CHAPTER 7: Lessons Learned

Some of the key "lessons learned", as reported by Energy Commission staff in their discussions with industrialists, are summarized below as anecdotal evidence regarding the delivery of energy efficiency services to industry:

- Industrial BP training workshops are effective by helping company personnel be more aware and interested in energy management.
- Plant ESA's are a useful decision making tool to industrial managers and lead to greater implementation of energy efficiency measures.
- Plant personnel who attend the BP workshops and participate in the ESA's are more adept in the use of the efficiency software tools to implement continuous energy efficiency improvements.
- When given accurate information, food industry managers are more able to consider a longer term planning horizon to invest in energy efficiency.
- Utility rebates are useful in helping lower simple payback periods to the point where the project is attractive to implement.
- Industry managers are aware that energy efficiency and conservation measures have a direct positive reduction to greenhouse gas emissions.

There are however, areas of concern and uncertainties to achieve optimal resource efficiency practices in California's food industry.

- The food industry is looking for total resource efficiency programs that provide incentives for the aggregated benefits of adopting energy, water and air resource efficiencies. The "silo" approach to Public Goods Charge energy efficiency programs is driven by equipment replacement. System Analysis and Life Cycle Assessment methodologies are needed to identify and capture the integration of resource efficiencies.
- The state's air emissions requirements and water quality standards are stringent in many jurisdictions. Company managers may have to adopt more energy intensive processes to meet these standards.
- Lack of guidance in the adoption of recent state law (AB 32) to reduce greenhouse gas emissions (GHG) creates uncertainty regarding energy efficiency investments. There are concerns that meeting GHG requirements will be burdensome and expensive.
- There is a shortage of skilled local workforce for industrial equipment operation and maintenance jobs.

CHAPTER 8: Case Studies

The following case studies represent a sample of the results obtained through ESA's conducted at two California food companies:

The Del Monte Foods Air System Assessment demonstrates the efficacy of the ESA to help company managers make investment decisions. The ESA encouraged managers to implement a medium-term effort to improve the plant's air system performance and achieve sustained electricity savings.

The Clougherty Packing LLC, Steam System Assessment became a catalyst for company managers to budget and implement ESA recommendations. The ESA provided factual evidence of the potential to achieve significant electricity savings that would pay back project costs within company investment guidelines.

A success story from the CALIFORNIA ENERGY COMMISSION

Compressed Air System Assessment

CASE STUDY SUMMARY

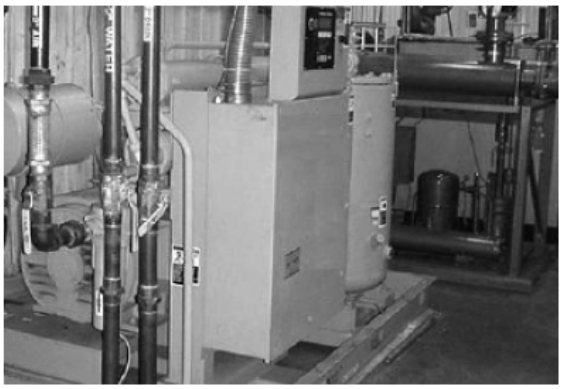
- Participant: Del Monte Foods Modesto, CA
- Industry Type: Food Processing
- Project Cost: $210,000
- Project Simple Payback: Less than 2 years
- Economic Benefit: Total Savings in Electricity $81,000 per year. Additional $65,000 Modesto Irrigation District Rebate

Air System Assessment at Del Monte Foods in Modesto, CA Identifies Potential Electric Savings of over $81,000

Del Monte Foods manufactures products ranging from canned fruits, and vegetables to pet foods sold under various national brand names. The production at the Del Monte plant in Modesto is seasonal, starting from late May to mid-September while August holding the highest production peak. In addition to manufacturing, the majority of the plant activities involve packaging, warehousing, shipment, and equipment maintenance on a 24 hour a day, 7 day weekly basis.

Plant Compressed Air System

Del Monte's compressed air is supplied by nine compressors as a single pipe system. Eight compressors and seven refrigerated driers are located at a semi-enclosed "compressor farm" near the plant's boiler house. These compressors range in size from 75 to 125 horsepower (hp) and supply a total of 4,300 standard cubic feet per minute (scfm) of air at a line pressure of 100 to125 psig. Average plant air demand ranges from a high of 3,600 scfm during the 13-week seasonal production period, to a low of 1,230 scfm for the 39-week winter production period. Major compressed air loads at the plant include cooking retorts; wrapping machines; color sorters; lid machines; open blowing for water removal and drying of cans prior to labeling; and pneumatic can opening machines.



During peak production season includes rental of two additional compressors rated at 100 hp/442 scfm and 75 hp/320 scfm to serve increased load. As a result of energy monitoring studies and the air system assessment, rentals are no longer utilized, reducing air system cost by $16,000 per year.

Energy-Saving Opportunities

Reconfigure Primary Air Storage System. Capacitance calculations determined that at least 4,125 gallons is required to reduce the rate of pressure decay during compressor unloading, absorb short duration plant peak air demands, and support air demand requirements during compressor permissive startup. It is recommended to allow approximately 1,000 gallons of wet storage, or 25% of the total 4,125 gallons of receiver capacity, to address water carryover that is causing undesirable pressure drop to certain buildings because of the need for extra filtration and a dedicated point-of-use drier in those locations.

Adopted recommendations to achieve optimal humidity removal and to remove compressor to compressor back pressure. Additional improvements to air system quality were adopted to reduce moisture, oil leaks, and particulate emissions increased total project costs. Although these "intangible benefits" are not quantified in total project savings, the quality improvements will reduce equipment maintenance costs.

Install Automatic Central Sequencer Master Control and Reduce Artificial Demand. To

obtain optimal energy efficiency, operating compressors should run at full load, rather than multiple partly-loaded compressors, with only one compressor functioning at part load possibly via a variable speed drive to provide trim. Although the target system supply pressure should be 86 psig, the plant is currently supplying pressure at 100 psig to overcome pressure drops caused by insufficient storage volume and extra filtration and drying issues related to water carryover. Installing wet storage along with its own downstream drier will allow removal of extra filtration and drying equipment that is causing the pressure drop. This method should reduce artificial demand by 10%.

Will adopt as part of long term optimization plan in 2009.

Reduce Leakage and Inappropriate Uses of Air. All plants have some uncontrolled air leakage and inappropriate uses of compressed air. A leak survey and management program should be implemented to identify and correct sources of leaks, provide training to plant personnel on inappropriate uses of compressed air, and investigate alternatives to open blowing and air-driven equipment used in plant processes.

Potential electric savings are estimated to be over 1,040,000 kilowatt hours or $65,000 each year. Managing leaks and eliminating inappropriate uses of air can add another 10% to 15% savings.

Installing a Central Control System. Along with reconfiguring the primary air storage system to include wet storage will enable better control of the plant air system, reduce artificial demand, and allow supply pressure to be reduced by up to 15 psig.

Including a $65,000 rebate from MID the avoided rental costs of $16,000 and the $65,000 annual savings from adopting recommendations brings the return on investment to a less than 2 years simple payback period.

A success story from the CALIFORNIA ENERGY COMMISSION

Steam System Assessment

CASE STUDY SUMMARY

- Participant: Clougherty Packing, LLC – a wholely owned subsidary of Hormel Food Corp.
- Products: fresh-cut pork, bacon, sausages, and cooked ham
- Location: Los Angeles, CA
- Therms Saved per year: 1,008,000
- Electricity Savings: 1,110,000 kWh per year
- Economic Benefit: total savings in cost up to $891,500 per year

Improvements in Boiler Efficiency and Other Best Practices Could Save Farmer John $891,500 and 1,008,000 Therms Per Year.

Clougherty Packing, LLC

processes pork products, including fresh-cut pork, bacon, sausages, cooked ham, and "Dodger Dogs" under the "Farmer John" label. The plant uses steam on a 52 week per year, 7 days a week, 24 hours per day schedule. Natural gas is used for firing the boiler system and electricity powers the motors, pumps, compressed air, and refrigeration systems. Energy consumed by the plant for 2005 is as follows: electricity 63,843 MWh (0.218 TBtu), and natural gas 3,849,170 therms (0.385 TBtu).

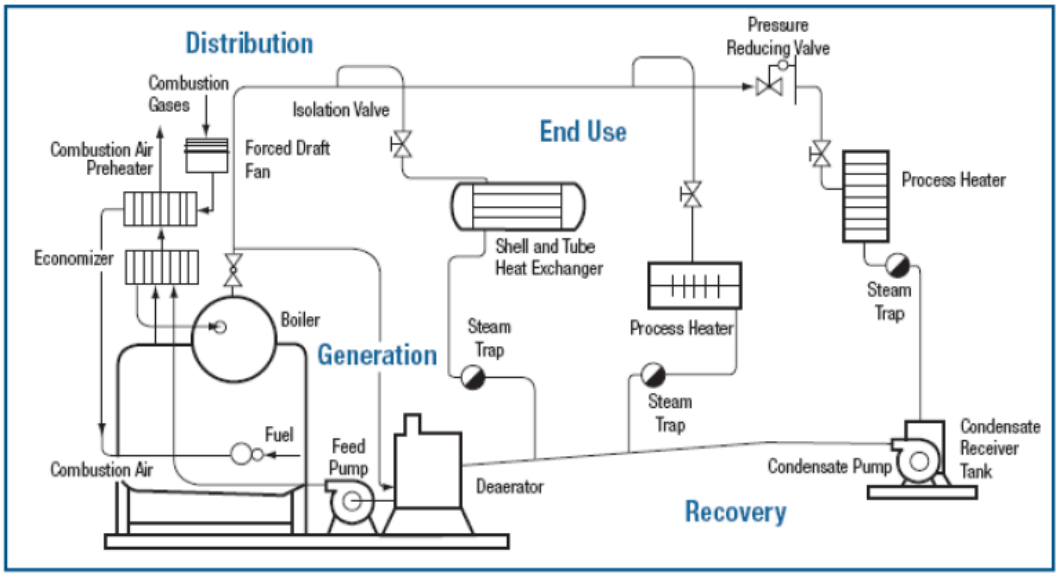
There are three watertube boilers and one firetube waste heat boiler producing saturated steam for the plant: one 1000 hp Combustion Engineering (CE) boiler producing 135 psig steam for the plant's rendering process with a letdown to 90 psig to provide

supplemental steam for the plant's low pressure steam processes; two Babcock and Wilcox (B&W) boilers rated at 500 hp each producing 90 psig steam for plant processes; and an "afterburner" with a heat recovery steam generator rated at 6,900 lb/hr to combust offgases from the plant's bacon, wiener, and ham smokehouse and produce an additional 5,000 lb/hr of 90 psig steam for the plant's processes. The afterburner is the least efficient boiler (37.3% stack loss) followed by the two B&W boilers (28% stack loss). The CE boiler proved to be the most efficient with only about 18% stack loss. These boilers meet the regional air quality management district 9 PPM NOX emissions standards. The blowdown rate for the boiler system is very high at >15% due to bad makeup water quality.

Energy Efficiency Opportunities

1. ***Install a New 900HP firetube boiler to replace the B&W boilers and Afterburner boiler:***

•Increase Boiler Efficiency: The new firetube boiler with boiler efficiency of 86% will be equipped with a feed water economizer, and an O2 trim controller to reduce oxygen content and temperature of flue gases. Currently, oxygen content ranges from 10.5 to 12%, with temperatures between 309o to 699o F and stack loss between 17.2% to 37.3%.



Steam systems include generation, distribution, end use, and recovery components
(Source: DOE, *Improving Steam System Performance, A Sourcebook for Industry,* available online at www.eere.energy.gov/industry/bestpractices.)

Reduce Boiler Blowdown to 2% with Reverse Osmosis (RO) System: Due to low quality makeup water from city deliveries, the current blowdown rate for all boilers are greater than 15%. To effectively reduce blowdown heat losses, a reverse osmosis system should be installed to improve water quality.

•Abandon Afterburner Boiler: The afterburner boiler is the least efficient system in the plant. We recommend abandoning the afterburner boiler and increasing the new boiler's load to absorb the 5,000 lbs/hr capacity of the afterburner boiler. To meet air quality requirements, we recommend installing a regenerative thermal oxidizer to treat the smoke-laden vapors from the plant's smokehouse that previously fed to the afterburner boiler. Eliminating the afterburner would save $598,000 but would increase steam demand for the new boiler and would increase annual fuel costs by $363,000 (Net savings $235,000 per year.)

***Adoption**: Received $25,000 boiler rebate and $300,000 grant from the Southern California Gas Company. Has already installed a 900 HP Superior Boiler with ST Johnson Ultra low NO_X burners with 02 trim and monitoring equipment such as flow meter. New RO and Softener system will be installed in mid November 2007. In March 2008, will install Regenerative Thermal Oxidizer (RTO) which is proven to have 96% thermal efficiency at another facility.*

2. *Increase Boiler Efficiency and Decrease Boiler Blowdown Rate for Existing CE Boiler or Install a new 900HP Boiler with PRV:* Installing a new boiler or retrofitting the existing CE boiler will increasing the boiler efficiency to 86% and reducing the boiler blowdown rate to 2%.

Installing a new boiler or retrofitting the current CE boiler will increase the boiler efficiency to 86% and reduce the boiler blowdown rate to 2%.

3. *Operate New 900 HP Boiler at 135 psig with a 100 kW Back Pressure turbine (135 psig to 90 psig) Instead of a PRV:* For the second project, there is an opportunity to save more energy with the addition of a back pressure turbine.

Has installed a second 900 HP Superior Boiler. Will implement turbine project in 2009.

4. *Increase Condensate Recovery:* The condensate returned from one of the heat exchangers in the plant drains into the plant's sump system. The condensate discharge rate is 5 gpm– greater than 2,500 lb/hr. We recommend this discharge be collected in a storage tank then

returned back into the de-aerator. Currently, direct steam is used for many heating processes in the plant without any recovery of condensate.

5. *Eliminate Use of 585 lb/hr Live Steam from Processes:* Live, uncontrolled steam used in the Ham Shrink Wrap Tunnel, Pork Cut, and Case Ready Salt Pork area can be eliminated with the use of a heat exchanger system. Benefits include return of additional condensate and a reduction in plant steam demand, condensation problems, and in dehumidification load on refrigeration equipment.

Purchased new DA tank.

6. *Install Blowdown Flash and Blowdown Heat Exchanger:* Currently, all blowdown water is going to a sump without recovery of any heat.

7. *Reduce Direct Steam Usage in Wash Stations:* Direct steam mixed with fresh water is used at hose stations. This direct steam use practice can be greatly reduced with the use of direct steam injection systems.

8. *Proper Insulation of Existing De-aerator and Associated Valves and Adjacent*

Approximately 50% of the insulation on the existing De-aerator system is missing. The associated valves and nearby pipes are poorly insulated.

Received $65,0000 grant from Southern California Gas Company in addition to the $25,000 rebate. Annual net saving up to $235,000 by adopting the recommendations of afterburner boiler elimination and installment of the new boiler will also increase efficiency by 86%.

APPENDIX A

Energy Efficiency Products and Services

Energy in Agriculture Program, Food and Fiber Processing Technologies

http://www.energy.ca.gov/process/agriculture/food+fiber_processing.html

Steam System Video

http://energy.ca.gov/process/videos/index.html

Food Industry Resource Efficiency Web Portal

http://www.nwfpa.org/eweb/startpage.aspx?site=Energy&design=no

APPENDIX B

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