Current and Potential CHP Use in the NY/New England Food Processing Sector

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ABSTRACT

The Food and Beverage Processing Major Group is comprised of a heterogeneous set of establishments involved in manufacturing or processing foods. Activities range from dairy production, fruit and vegetable canning and preserving, to bakeries, animal slaughtering and processing. To understand the CHP potential of the sector, it is critical to focus on specific sub-sectors and their unique manufacturing processes.

Energy use in the sector ranges from 1% to 2% of total costs in low intensity processes to as much as 20% in the most energy intensive. In total Food Processing is the fifth largest consumer of energy in the U.S. industrial sector.

Food Processing businesses are a critical part of the industrial base. The 2002 Economic Census reported 1.508 million persons employed in 26,374 Food Manufacturing establishments generating $457 billion in sales. It ranks second in employment and second in sales among 21 manufacturing groups. In the NY/New England region, Food & Beverage Manufacturers provide 113,000 jobs at 4,000 sites paying total wages of $4.0 Billion.

The State Advisory group to the Northeast CHP Application Center identified Food Processing as a key target sector. Certain economic development agencies in the region designated the food industry cluster as a sector for specific programmatic outreach.

An effective program for increasing penetration rates requires a needs assessment of particular sub-sectors. There are potential applications in the area of conversion of food processing waste streams to "opportunity fuels". This type of application should not be overlooked when considering the economics of onsite power generation.

Energy/Economic Analysis of the Food Processing Sector

The Food Processing sector is comprised of a number of industry groups engaged in a variety of processes including dairy production, fruit and vegetable canning and preserving, bakeries, animal slaughtering and processing and so on. A complete list of the industry groups in the Food Processing sector is found in Table 2. Below are energy and economic analyses of the sector nationwide and in the NY/Northeast region.

National Overview

Energy. The food processing sector is the fifth largest consumer of energy in the U.S. industrial sector. It is among the top 5 in direct use of natural gas, consuming 553 Billion cu. ft. which represents 7.7% of the total industrial sector. According to the Energy Information Administration's Natural Gas Industry and Markets Report (2003) about 6 Tcf of natural gas, which is more than 80 percent of the industrial use of natural gas, is in six sub-sectors of the industrial sector of the economy: chemicals, petroleum refining, primary metals, food and beverages, paper, and stone/clay/glass.

While the absolute amount of energy consumption in the Food Processing sector is high, most of the industries that comprise the Food Processing group are not particularly energy intensive, as compared with other industries. Energy costs as a share of total value of shipments tends to be less than 2% for most of the food processing industry.

Food processors used nearly 1,044 trillion Btu of energy according to the 1998 MECS. Energy use per employee in the Food Processing sector was 767.8 MMBTU's which is substantially less than the manufacturing sector average of 1,101.1 MMBTU's per employee. Food processors consumed 2,400 BTU's per dollar of sales as compared with the manufacturing sector average of 4,600 BTU's per dollar of shipments.

The somewhat low energy intensity of the sector relative to manufacturing as a whole does not diminish the potential for increased efficiency in this area. There are components of the industry that are quite energy intensive and there are significant opportunities for energy savings due to the size of the industry and its total energy use. While energy represents on average between 1 and 2% of total operating costs, in some industry sub-sectors energy comprises as much as 20%. Major energy end-uses include drying, refrigeration, process heating and cooling, and machine drives."[1]

Economics. Nationwide, the 2002 Economic Census reported that there were 1,507,923 persons employed in 26,374 Food Manufacturing establishments. This sector generated $457 billion in sales. The average wage per paid worker was $30,144 (in 2002$'s). The food processing sector ranks second largest in terms of employment among all of the manufacturing sectors behind Transportation Equipment. It ranks #2 among the 21 manufacturing major groups in terms of total sales. Over the 1999-2004 period, job loss has occurred in all of the 21 manufacturing sectors. The rate of decline in Food processing (-0.68%) is far less than the manufacturing sector as a whole (-3.77%).

Regional Energy and Economic Background

Energy usage. In the Northeast Region (including the Mid-Atlantic States: NJ and PA) total electricity consumption in the Food Processing sector was 5,740,000 MWH's according to the 1998 Manufacturing Energy Consumption Survey (MECS). That figure represents 5.62% of total manufacturing electricity consumption in the region.

Energy prices in the NY/New England region tend to be higher than the national average. This makes CHP use more attractive in the region, as the potential returns to more efficient use of energy have a markedly higher payoff.

Economics. According to the U.S. Department of Labor in 2002, 3,798 Food Manufacturing establishments in the NY/New England region employed 99,623 people. Of the 99,623 employed, 53,488 people were employed in New York. Overall, Food Manufacturing generates $3.3 billion in total wages with the average annual pay per employee ranging from a low of $24,759 (RI) to a high of $34,849 (CT).

[1] *Symposium will hit on energy issues*, February 27, 2002.

Food Processing: 2002 Wage and Employment Data for NY & New England

	Region	NY	MA	CT	ME	NH	RI	VT
Establishments	3,798	2,045	841	268	215	104	185	140
Total Employees	99,623	53,448	22,563	7,401	6,586	2,432	3,206	3,987
Total Wages ($Million)	$3,296.5	$1,802.6	$769.0	$257.9	$182.9	77.7	$79.4	$127.1
Average Annual Pay	$33,090	$33,726	$34,084	$35,849	$27,766	$31,934	$24,759	$31,887

When analyzing the food processing Major Group its important to look at the sub-sectors which comprise it. The kind of manufacturing activity varies widely from cheese making, to snack foods to meat and poultry rendering operations. Clearly the underlying manufacturing processes for this broad group of activities are quite distinct.

More than 78% of region wide employment in the Food Processing Sector is accounted for by the following 5 of the 10 industry groups:

- BAKERIES & TORTILLA MANUFACTURING 32.1% of jobs
- DAIRY PRODUCT MANUFACTURING 13.7% of jobs
- BEVERAGE MANUFACTURING 12.0% of jobs
- FRUIT & VEGETABLE PRESERVING 10.5% of jobs
- SNACK FOOD MANUFACTURING 9.9% of jobs

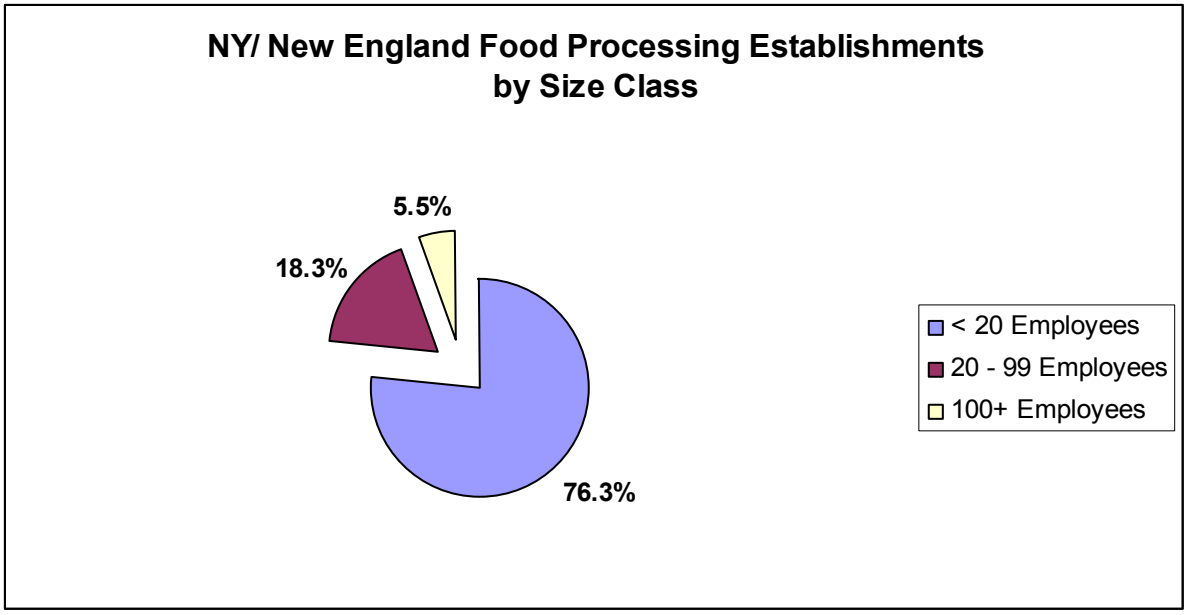
Food Industry Sub-Sectors	Employees	Establishments	Pct of Jobs	Pct of Establishments
BAKERIES & TORTILLA MANUFACTURING	35,701	2,171	32.1%	54.1%
DAIRY PRODUCT MANUFACTURING	15,167	219	13.7%	5.5%
BEVERAGE MANUFACTURING	13,345	325	12.0%	8.1%
FRUIT & VEGETABLE PRESERVING	11,670	199	10.5%	5.0%
SNACK FOOD MANUFACTURING	11,046	321	9.9%	8.0%
ANIMAL SLAUGHTERING & PROCESSING*	8,418	222	7.6%	5.5%
SUGAR AND CONFECTIONARY PRODUCTS	7,866	298	7.1%	7.4%
SEAFOOD PREPARATION AND PACKAGING*	4,501	150	4.1%	3.7%
ANIMAL FOOD MANUFACTURE*	2,191	80	2.0%	2.0%
GRAIN & OILSEED MILLING*	1,167	26	1.1%	0.6%
REGION TOTALS	111,072	4,011	100.0%	100.0%

* These industries are undercounted due to non-disclosure of employee and establishment data.

The New York/New England regional total employment in Food Processing is on the order of 100,000 employees at 3,700 establishments. The total wages paid by firms in the industry in this region was approximately $3.3 Billion in 2003. The Beverage manufacturing industry group has a significant presence in the region accounting for about 13,350 jobs at 325 sites and paying a total wage of $633 Million. The national system of industrial classification no longer categorizes the Beverage manufacturing industry in the same major group as food processing.

Taken together, the Food Processing and Beverage Manufacture industry groups provide more than 113,000 jobs in this region, operating at more than 4,000 sites and paying total wages of nearly $4.0 Billion.

The preponderance of establishments in the food processing sector is small businesses with less than 20 employees. The chart below depicts the percentage of all establishments that fall into one of three size classes. More than 76% of the 3,700 establishments have fewer than 20 employees. A little more than 18% of establishments have 20 – 99 employees and just 5.5% of the establishments in the region have 100 or more employees.



CHP Use in the Food Processing Sector

Benefits

The food processing industry can achieve many benefits from CHP:

- May double energy efficiency
- Recovery of usable "waste" heat for process heating, thermal processing and dehydration, cooling, and space conditioning
- Power reliability to prevent expensive downtime in the event of a power outage
- Waste remediation, an increasingly important industry driver
- Reduced environmental impact

There are a number of factors that may make CHP use attractive to businesses in the Food Processing sector. These factors can be categorized into areas including consumer driven trends, processor requirements and the macro-economic environment (gas and electric prices, economic growth and capital investment).

Consumer Driven Trends

Changes in consumer tastes have lead to a greater demand for more energy intensive products. Consumers are spending more on highly processed, energy intensive products such as pre-cooked meats, prepared meals, and other prepared food products that have higher energy input content.

Processor Driven Factors

CHP can be an attractive solution in those instances where there is large, coincident and relatively constant (hours per year) need for thermal and electric power.

In the food processing industry thermal energy is used for process heating/cooling and space conditioning. Thermal processing and dehydration are the most commonly used techniques for food preservation, and require significant amounts of energy. Process heating uses approximately 29% of total energy in the food industry, while process cooling and refrigeration demands about 16% of total energy outputs.[2]

Some Food processors may find CHP attractive as a means of providing more reliable and higher quality power to their facility.

Food safety is a critical concern for firms in the industry. CHP systems may be integrated in strategies to enhance/upgrade sterilization operations. Similarly, more efficient water usage is a concern for many in the industry. Onsite power generation and waste heat utilization may complement water efficiency investments

Macroeconomic Factors

The dominant factor making CHP attractive for a Food Processor, or any other business, is its ability to lower total production costs, improve productivity and enhance profitability. In areas where electric costs are high the value of CHP is greater. As the difference between the input fuel for generating power on site (natural gas) and electric prices narrow, a narrowing of the "spark spread", the attractiveness of the CHP investment diminishes.

A growing and vibrant market outlook leads businesses in a region to look at new capital investment opportunities. Sites may need to upgrade equipment to meet rising demand, or simply as a matter of replacement of aged less efficient capital stock. The capital upgrade cycle presents an opportunity for installation of a CHP system.

Changes in the market outlook may lead the firm to expand its hours of operation. Food processors in some instances have seasonal operations with marked differences in the seasonal peaks. If market conditions permit greater intensity of operation on a year-round basis, the CHP investment becomes a more attractive one.

The price of natural gas has been high and volatile within the last couple of years. CHP projects that looked attractive at gas prices prevailing and forecast in 2000 and 2001 no longer

[2] Dr. Martin Okos, et al. *Energy Usage in the Food Industry*, October, 1998.

look nearly as attractive at today's prices. In their most recent annual report on the Natural Gas Industry and Markets the Energy Information Administration reports that in 2003 the national annual average natural gas wellhead price was $4.88 per thousand cubic feet (Mcf). This is the highest wellhead price (based on 2003 constant dollars) in the Energy Information Administration's historical data series dating to 1930.

Projections of future costs remain well above the long-term average. Until significant new sources of gas supply are brought online prices are likely to remain well above long-term historical levels. These conditions increase the economic viability and desirability of utilization of opportunity fuels.

For cheese manufacturing facilities, breweries, and wineries CHP may be attractive because of the potential to use an "opportunity fuel." These industries generate wastes that contain high levels of biological oxygen demand (BOD), which might not be tolerated in municipal sewers or might cause expensive sewer surcharges. Such facilities are good candidates for utilizing anaerobic digesters (AD) to treat waste and produce biogas to fuel a CHP system. Food wastes can be sent to an AD, such as the conventional cylinder type, to generate affordable digester gas. This gas has a heating value of about 600 Btu/cubic foot, or about 60% of that for natural gas.

Sewer charges are based to a large extent on the level of Biological Oxygen Demand (BOD) of the effluent stream that is discharged to the sewerage system. If a facility can markedly lower the BOD level of its waste stream it could save a significant amount in costs.

Market Inhibitors

Factors inhibiting the use of CHP tend to be the opposite side of the coin of those that would favor or drive its usage. The lack of a sizeable, coincident and consistent demand for thermal and electric energy is of course a key factor.

Food processors may operate seasonally, or may have markedly higher levels of operation during certain parts of the year, dropping to a low level of operation at other parts of the year. *Food Engineering* Magazine quotes Ed Yates, Executive Vice President of the California League of Food Processors:

"In retrospect, a lot of money was wasted on self-generation projects," notes Yates. "The price of electricity isn't quite high enough to justify co-generation, and most of the state's processors operate seasonally."

Another critical issue is competition with other business investments for scarce internal capital budgeting dollars. The payback periods that those in the industry see as acceptable have been reported to be in the range of 2 years or less. Rick Payton, director of motor marketing for Rockwell Automation's power systems business unit in Greenville, S.C. states, "Customers used to want a payback in three years. Now they want it in one year. "

In California, interest in CHP was fueled by the California Self-Generation Incentive Program. This program was set up in response to the California energy crises in 2000. California Natural Products, a Lathrop, Calif., processor of rice-based ingredients and low-acid aseptic products, was among the firms to take advantage of the program. The company's new on-site CHP system came online in the first quarter of 2003. "If I had to go out and buy this system

today, I couldn't," reports Pat Mitchell, the company's CEO. He projects a four-year payback on the project.[3]

Across the region, lack of financing is a major issue. As discussed in articles such as *The Utility Management* by Kevin Higgins, featured in Food Engineering, April 2003, convincing owners to invest in CHP technology is often problematic due to the high initial capital expenditure and difficulties with predicting payback, or the existence of a long-term payback.

Utility standby tariffs may also be a deterrent. The Rhode Island SEO reported that the cost of utility backup power is a major inhibitor in Rhode Island, and possibly other states as well. In addition, many developers have remarked that few business people want to be pioneers in this area. Therefore, it is important to emphasize that CHP is already widely used in the Food Processing Industry. Education and outreach is critical for increasing CHP investments, particularly for smaller-sized operations.

Current CHP Use in Food Processing Industries

Nationwide CHP penetration. CHP is a technical solution that is already in operation at hundreds of establishments within the food processing sector. In a report on existing CHP applications in place at a national level, the Energy Nexus Group identified approximately 4760 MW's of CHP in the Food Processing Sector, representing 9% of the total CHP in place in 1999.[4] A more recent estimate of total CHP in use at food processing establishments nationwide is 6046.3 MW's as of 2002 [5]

Among the subsectors, Fruit and Vegetable Processing has the greatest level of current CHP use

- Fruits and Vegetables: 2,767 MW
- Grain and Corn Processing: 784 MW
- Sugar, Candy, Gum, Nuts: 699 MW
- Seafood, Ice, Prepared Foods: 491 MW[6]

Northeast region CHP statistics. Data for existing CHP in the New York / New England region is not readily accessible. However, the 1998 Manufacturing Energy Consumption Survey (MECS) reports that CHP in use at Food Processing plants accounted for 339 GWH of total electricity production in the Northeast Census Region (this included NJ and PA in addition to NY/New England)

According to the 1998 Manufacturing Energy Consumption Survey (MECS), the total fuel consumption was 78 trillion Btu and the total electricity consumption was 5,740,000 MWH's in this region. MECS does not examine the Energy Consumption, usage and generation

[3] The Utility Management. Kevin J. Higgins, Food Engineering Magazine. April 2003.
[4] Market Potential for Combined Heat and Power, presented by Dr. Bruce Hedman to the Fall ASERTTI Meeting. October 10, 2001 pg. 7.
[5] Market Potential for Combined Heat and Power. Presented by Dr. Bruce Hedman of Energy and Environmental Analysis Inc. to the Alexandria Research Institute. May 30, 2003 pg. 9.
[6] Information from USCHPA.

characteristics of any of the industries or sub-sectors within the Food Processing Sector, with the exception of Corn Milling (NAICS 311221).

Total Capacity usage figures for the Northeast Region are not published by the MECS. However, a database under development for the US Department of Energy with the support of the Regional CHP Application Centers has identified 22 food processing sites (246 MW's) using CHP in the NY/New England region

CHP Targets in the Food Processing Sector

Bakeries and Tortilla Manufacturers

An obvious target industry in the Northeast is Bakeries and Tortilla Manufacturers. They account for nearly one-third of the jobs and more than 50% of the firms in the region. Commercial bakeries, pasta and tortilla manufacturers require hot water and steam for sanitation purposes and process needs creating sizeable thermal loads. Sites require cool air and water to prevent overcooking and for cooling of equipment (extruders)

This subsector has numerous successful CHP applications. In New York, Entenmanns Bakery in Bayshore installed a 2100 HP system in 1994. Continental Baking (Queens) employs a 720 H.P system. The Rockland Bakery (840 k) and Damascus Bakery (120 kW) were awarded NYSERDA funding in the last few years. In Massachussets, Iggy's Bread is exploring the possibility of employing biodiesel to produce combined heat and power for its industrial operations. The study will evaluate two sources of renewable biodiesel fuel: 1) on-site processing of collected waste vegetable oils and 2) purchasing of pre-produced biodiesel. Either source of 100% biodiesel would fuel a 60 kilowatt generator with heat recovery capability to provide both electric and thermal energy to the bakery in Cambridge.

In Connecticut, Pepperidge Farms completed a state-of-the-art bakery plant in Bloomfield, Connecticut, in September 2003. The facility will run three shifts, six days a week. It contains four production lines and employs approximately 275 people. A fuel cell power plant is expected to provide about 20 percent of the facility's base load power, with the heat byproduct being used for process steam for the bakery. PPL Energy Plus will own the unit and sell the electricity and heat to Pepperidge Farm under a power purchase agreement. In another Entenmanns' Bakery in Northlake, Illinois, a 1.6 MW CHP facility meets the base load electricity requirements. Two Caterpillar natural gas fueled reciprocating engines operate in parallel with the electric utility that provides supplemental, maintenance and back-up power. Approximately 7 MMBtu/hr of heat is recovered from engine jacket water and exhaust for process and sanitation use.

Beer Breweries

Nationwide $17.6 billion in revenue is generated from the production of beer, ale, and malt liquors (U.S. Census Bureau). The US brewery market saturation of CHP systems is 22%, with 652,000 MWh generated (EOLB Natl Lab). In the Northeast region there are 2,400 brewery jobs at 60 sites. NY and MA account for 29 sites and 1,920 jobs. There is a significant need for reliable power to maintain exact heating and cooling during brewing. "The worst place to lose power is in the brewhouse," one brewery official noted, since it would spoil a whole batch worth tens of thousands of dollars. Beverage safety/sanitation and Environmental Health & Safety concerns (especially in larger breweries) are key drivers in the brewing industry.

Spent grain from early processes and spent yeast from fermentation process could undoubtedly be turned into methane with anaerobic digesters for affordable biogas. This would avoid wastewater treatment and other disposal charges while producing methane to feed into a CHP systems.

Reciprocating engines, with a power size range of 30kW–8MW, generate engine jacket heat from 180-200°F, and exhaust heat at around 1200 °F. Industrial turbines, with a power range from 1-20+ MW, generate heat from 900-1100°F. This heat can be recovered and used to heat or cool products in a variety of food processing steps such as:

- High thermal loads in several steps in the brewing process--e.g.in the brew/mash step that activates enzymes with heat, and in heating and cooling liquids processes
- Grist from the roller mill is mixed with hot water, and the mixture must be heated further to form mash (Brewer's Handbook)
- Wort must be boiled from 1-2 hours (Brewer's Handbook)
- Wort must be cooled from 95-96 degrees Celsius to 0-5 degrees Celsius, typically through use of plate heat exchangers (Brewer's Handbook)
- Temperature must be regulated during fermentation to facilitate the reaction (Brewer's Handbook)
- Beers may be clarified using lagering, centrifugation, or fining – lagering requires cold temperature of 1-2 degrees Celsius, and occasionally use of a pressurized tank (Brewer's Handbook)
- Most beers are pasteurized, requiring temperatures from 60-75 degrees Celsius for up to 30 seconds (Brewer's Handbook)

Opportunity Fuels; Breweries, Food Processing & Wineries

Wherever there is a large amount of food waste there is potential for anaerobic digestion. An interesting brewery case study is the New Belgium Brewing Company in Fort Collins, CO, where an on-site anaerobic digester processes up to twenty million gallons of wastewater each year. By feeding their autolyzed yeast to the anaerobic digester, they have been able to run the CHP system for 3 times as long (from 5 hours to 15 hours a day). The biogas produced during the wastewater treatment is used as fuel for a 290 kW internal combustion engine that provides a portion of the brewery's electricity. The engine's cooling jacket and exhaust gases preheat water to be used in the brewing process.[7]

Seneca Foods, a corn and pea processor in Montgomery, Minnesota uses an anaerobic digestion system. Utilizing a proprietary technology that simultaneously treats both the solid and liquid waste, it is estimated that 85% of the solids treated is converted to useable gas. The gas goes through considerable cleanup, and then can either be piped back into the natural gas supply line, or used to power a 1.5 megawatt generator (Minnesota Clean Energy Resource Teams -- Southeast CERTs Draft Plan).

[7] A case study is available at the Intermountain CHP Application Center website.

Dairy Product Manufacturing

The Dairy Products Industry group is the second largest among the Food Processing groups in New York / New England employing more than 15,000 people at 219 sites.

Daily Products Manufacturing: NY & New England (2003)

	Region	NY	MA	CT	ME	NH	RI	VT
Establishments	219	122	26	16	11	8	12	24
Total Employees	15,167	8,462	2,930	926	551	326	190	1,782
Total Wages ($Million)	$3,296.5	$1,802.6	$769.0	$257.9	$182.9	$77.7	$79.4	$127.1
Average Annual Pay	$33,090	$33,726	$34,084	$34,849	$27,766	$31,934	$24,759	$31,887

Industry drivers include a need for power Reliability – power failure and subsequent loss of refrigeration systems results in spoiled milk products and a loss of revenue ***Food safety*** is key; a constant supply of steam and hot water ensures that milk products are being properly disinfected and processing equipment is being sanitized. Milk processing is an energy intensive industry, requiring 167 kWt and 56 kWh of thermal and electric energy respectively per ton of milk produced – fluid milk processors spend over $160 million on purchased electricity annually (UNFAO).

Thermal energy can be used to heat or cool products in a variety of food processing steps such as:

- Thermisation – heating raw milk to extend refrigeration time – requires temperatures of 57-68 degrees C for 15 seconds (Dairy Training & Development Council)
- Pasteurization – heating milk to destroy microorganisms and enzymes – requires heating the milk to at least 71.7 degrees C for 15 seconds, followed by an immediate cooling to 6 degrees C (Dairy Training & Development Council)
- Sterilization – filled milk bottles are sterilized after packaging – bottles conveyed through a steam chamber at 110-130 degrees C for 10-30 minutes (Dairy Training & Development Council)
- Ultra heat treatment – quick sterilization process that does not destroy milk chemistry – steam heats milk to 140 degrees C for a period of 1-2 seconds (Dairy Training & Development Council)
- Large refrigeration capacity required to store raw and processed milk
- Bottles/packaging must be sterilized before being filled

Cheese Manufacturing

This sub-sector has an annual sales value of over $22 billion in cheese products manufactured from raw or processed milk, and cheese substitutes manufactured from soybeans and other non-dairy ingredients (U.S. Census Bureau). Over eight billion pounds of cheese are manufactured each year (IDFA). 37% of milk production is used to produce cheese (IDFA)

Industry drivers include a need for power reliability – a disruption in the grid can result in large amount of spoiled milk and cheese because of production equipment failure. Food safety dictates that a constant, reliable source of heat and power is needed to maintain the necessary conditions for safe food processing. 22 U.S. Dairy Sites from a total of 1830 have CHP (165.2 MWe) for market saturation of 1.20% (Energy and Environmental Analysis).

Summary

The Food and Beverage Processing Major Group is comprised of a heterogeneous set of establishments involved in manufacturing or processing foods. In order to understand the CHP potential of the sector, it is critical to focus on specific sub-sectors and the unique manufacturing processes in which they are engaged.

This industry remains very important to the economy of the New York / New England region. The State representatives on the advisory group to the Northeast CHP Application Center have identified Food Processing as a key target sector. Certain economic development agencies in the region have designated the food industry cluster as a sector for specific programmatic outreach.

Food processing tends to be localized and is characterized by a few large firms accounting for a large share of industry shipments, and likewise a large number of small establishments which in many instances are a vibrant part of the market. Recent studies in the New York Metro Area found that the Food Processing sector was continuing to grow in the urban region. The growth segments included operations such as ethnic foods, specialty breads and pastas.

While many food processing sub-sectors make ideal candidates for CHP, the uptake of this technology has been slow due to a number of market, regulatory, and cultural barriers. These include cross-cutting hurdles that affect small industry generally (e.g., access to capital; perception of risk; standby rate and interconnection), and issues that are unique to the food processing sector. In the latter category, many firms in the food processing industry, particularly in the specialty foods area, are small, family owned operations and follow traditional production methods. Another difficulty cited by developers trying to break into this market is language barriers, as ethnic food lines represent a large and growing segment of the industry, particularly in larger urban areas such as NYC and Boston. As a result, past CHP education and outreach efforts may have not been fully responsive to the needs of these communities.

An effective program for increasing penetration rates needs to begin with a needs assessment of the particular sub-sector. There are some important potential applications in the area of conversion of food processing waste streams to an “opportunity fuel”. This type of application should not be overlooked when considering the potential economics of onsite power generation.

The most important factors that may inhibit CHP applications include perception of risk, capital access, and other “core” industry investments taking precedence over a CHP capital expenditure project.

Education and outreach designed to reach the Food Processing business owner within their own setting is likely to be most successful. Peer-to-peer exchange of success stories will be essential to spurring greater levels of industry investment in CHP applications.

In conclusion several factors influence which sites are most likely to adopt CHP on a broader scale. They may include:

- Industry growth, i.e. will end-users need additional capacity and will they have the capital to finance CHP projects
- Opportunity for significant, coincident, and sustained thermal energy use
- Those who own (not lease) space
- Those who are willing to accept somewhat longer economic payback periods
- Those with older equipment such as boilers which can be replaced with modern CHP system for greater efficiency. Boilers are fine for making process heat/steam, but are sometimes inefficient in making electricity via generators. CHP can make both electricity and usable heat.
- Opportunity fuels such as digester gas to supplement more expensive natural gas
- CHP technology advancements such as adsorption chillers (as opposed to absorption chillers) which can achieve lower cooling temperatures, organic Rankine cycle generators which can use low-quality heat to generate electricity, etc.
- Industry drivers which could be unique to subsector, such as need for power reliability to keep chocolate flowing in confectionery market.