Merging of the Industrial Customer's Goals with Energy Efficiency

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ABSTRACT

The industrial customer's goal is to produce as much saleable product while reducing overall manufacturing expenses. In theory, this concept appears to coincide with energy efficiency because a reduction in utility costs is a decrease in manufacturing expenses. However, in practice, the complex nature of industrial facilities illustrated by the incremental modifications over many years produces built up systems. The tipping point for a process improvement involving these systems is not as clear or consistent with the decision making process of standard retrofit projects. The reality is that it is not uncommon for industrial facilities to not track the energy metric per production unit as a common practice in their business. Additionally, even if they do track the energy intensity, it is not a primary measure of success for a plant or a capital improvement project. This is in direct contrast to state level strategic energy plans that focus on this metric. For industrial plants, the production efficiency must be considered to align the benefits of the industrial energy efficiency project with the state and utilities' goals. This paper will provide insight into this dilemma as well as focus on the general evolvement of the typical industrial facility in terms of systems and equipment. A case study will be presented to illustrate who an energy efficiency project took a whole facility approach in a plastic manufacturing plant. The results of the project were a vastly improved production efficiency (kWh/lb) and the facility nearly doubled the annual production output with a marginal increase in facility energy consumption.

Introduction

Due to their high levels of energy demand and consumption, industrial market segments are targeted by Utility energy efficiency programs. These programs provide incentives for industrial facilities to reduce overall energy consumption and peak demand. The facility, in turn, spends less money on energy which helps to reduce operating costs. Since industrial facilities are looking to maximize saleable product while minimizing manufacturing expenses and a significant manufacturing expense can be energy costs, industrial customers and utility programs seem to have a unified goal: energy reduction. However, as industrial facilities continue to evolve and innovate over time to stay competitive, the focus of an industrial customer and the goals, rules and incentives of a utility program can appear to diverge unless a unique, holistic approach is taken to educate and evaluate the facility as well as implement future changes.

Industrial Facility Goals and Evolvement

As industrial facilities are constructed, they are designed for a desired output level of a determined product. Ideally, the facility design team utilizes best practices and sizes systems accordingly, meeting all code requirements and optimizing system performance. The goal is to provide infrastructure for predicted production levels in a cost effective manner. Before utility incentives were available and building codes became more stringent, these designs focused mainly on upfront or first costs. Facility design teams often used heritage designs, whether or not the design was efficient. Today, in many new industrial plants, both upfront and lifecycle costs are often considered during the design phase. In this phase of facility evolvement, utility and company goals are somewhat aligned since energy conservation is pursued by both the company and the utility.

In the case of older facilities, after a few years of operating as planned, the parent company may decide to add a new product line, significantly increase throughput, or change product. Because the "bottom line" is of utmost importance to management, facility teams need to ensure the plant is operating and meeting production goals. Equipment is often borrowed from other plants or is ordered new and installed in haste. The purchase cost of the equipment is always considered, but the lifecycle or operating costs are often neglected. The end result is an evolved facility that produces more product, but likely costs more to operate on a per unit basis. In this phase of facility development, company and utility goals diverge since the company shifts focus to production changes rather than energy reduction.

Several years into the facility's operation, corporate changes, such as parent company "buy-outs" or reorganizations, occur that further defray priorities. In these events, the existing facility is now either used as the primary plant or is decommissioned. If it is used as the primary plant, production levels often increase to make up for closed plants, requiring more systems and equipment to obtain the higher output rates. The primary plant might receive some new equipment from other facilities that are being decommissioned. However, this equipment has not been designed for the usage in the primary plant and it is also common to piecemeal a system from multiple plants. These two aspects often yield improper sizing of equipment and poor compatibility and control. As an example, a chilled water pump in the decommissioned plant may have only had 40 feet of pipe run to the process. However, due to space constraints when the system is installed at the primary plant, the chilled water plant is located 200 feet from the process. The load requirements remain the same but the losses in pipe runs are larger and the delivery of enough chilled water will likely be hindered. After attempting to commission the system, the plant will likely add a booster pump to solve the chilled water supply issue. Another example includes a compressed air system. Process equipment and the associated air compressor are brought in to the primary plant. Typically, the air compressor is simply added to the existing compressed air system. In this instance, compressed air controls are often neglected, which is the silent efficiency killer. Assuming adequate total capacity, the process will be getting the air required but the compressors are likely to be fighting each other and not operating efficiently. Thus, the inefficiencies of the system go unnoticed and are not corrected until the system is studied in-depth.

The potential buyout, facility expansion, or strategic consolidation of facilities presents a great opportunity for a team to engage in the facility and evaluate its design and overall operation. If the facility is approached holistically, energy costs could decrease while production levels meet the company's goals. However, if a holistic approach is not pursued, as described earlier, the end result is likely a facility that produces more, but also costs more to operate on a per unit basis. The increase in operating costs will not be addressed until well after the commissioning process has been completed. During this phase of facility evolvement, the utility and company goals can either converge or diverge, depending on the approach taken to implement changes.

Energy Reduction as Cost Reduction

Even though energy is a significant contributor to overall operating costs, the pursuit of energy reduction often takes a backseat to increasing production rates. Energy reduction can be a time- and capital- intensive undertaking while new orders and higher demand for product are time- and market- sensitive. The CPUC Energy Efficiency Strategic Plan describes the primary focus of the industrial facility as optimizing industrial output, not energy throughput (CPUC, 42). When a facility introduces a new product or receives a large order, the production and product roll-out become primary stimulus from executives and all other aspects, such as energy efficiency, are diminished. Hasty, short-term decisions are made and these motivations serve as a barrier to energy efficiency during an expansion mode.

Typical drivers for energy efficiency in industrial facilities are utility incentives, overall cost reduction, and/or company mandated goals. Utility energy efficiency programs payout on either a "prescriptive" rate per item installed or on measured and verified savings (at a predetermined $/saved energy metric rate). In order to meet corporate reduction goals, minimize cost, and take advantage of utility incentives, energy efficiency can be an important consideration when making incremental improvements to a plant. The problem is that these incremental improvements often involve single systems or are for a single line, and may not be evaluated in terms of the overall facility performance. Facility managers or engineers tasked with leading these projects and making recommendations usually do not have expertise with industry's best practices and efficiency opportunities related to their facility's operations from equipment, and process improvements (CPUC, 41). Due to implementation time constraints and cost-consciousness of project designs, time or outside resources cannot always be dedicated to an efficiency study of the facility. The complex nature of the facility process and the fear that production could be negatively affected in terms of quality or quantity also serves as a barrier to evaluating the facility within the context of a holistic approach. However, system optimization provides the greatest opportunity to improve facility's efficiency. Authors for the "Industrial Development Report 2011: Industrial energy efficiency for sustainable wealth creation" published by the United Nations Industrial Development Organization (UNIDO) even write:

> Experience shows that while efficient energy components, such as pump, steam and compressed air systems, can raise average efficiency 2–5 percent, system optimization measures can yield 20–30 percent gains–with a payback period of less than two years. Further gains can be achieved if systems are optimized in tandem with production processes, for example, by reducing raw materials or other inputs. (UNIDO, 44)

Considering all of the barriers to a complete facility overhaul or holistic approach to energy reduction, it usually seems more feasible for facility personnel to implement the one for one retrofit project that meets the company's payback criteria reasonably well and has little production risk associated with it. While energy efficiency projects for these stand-alone systems can yield moderate savings, the savings are often difficult to see on the utility bill and are difficult to account for from year to year. These "imprecise evaluation methods help explain why companies sometimes decide against profitable energy-efficiency investments and for non-profitable production investments" (UNIDO, 93).

Tracking and Usage of Energy Intensity by the Industrial Facility

While the parameters to calculate an energy intensity metric (EI) are typically known, the usage of the metric will vary greatly from industry to industry, company to company, and even facility to facility. All facilities know their production and most know their energy costs and usage. However, equating the two into a useful metric can have some inherent challenges.

For the facilities that track, monitor, and optimize EI there are some common traits. First, large companies are more likely to be evaluating performance on EI than smaller companies. These large corporations tend to have corporate energy departments that focus on EI and other metrics to evaluate the performance of different facilities. Additionally, these large corporations are more likely to have corporate energy savings goals and it is common to normalize energy use. An example of this is 3M which targets a percent reduction in energy use per pound of product as well as a percent reduction in energy versus net sales (Reliable Plant).

Figure 1. Sample 3M Plant Energy Dashboard

3M										
May 18, 2004	2003 Q1	Q2	Q3	Q4	2003 Total	2004 Goal	2004 Q1	Q2	Q3	Q4
Energy Trend										
Btu/ Pound of Product	5,044	4,272	4,844	4,071	**4,475**	**4,251**	4,772	4,772	4,772	4,772
Change[1]	-0.38%	-8.64%	0.58%	-2.45%	**-2.98%**	**-4%**	-5.39%	11.69%	-1.49%	-17.22%
Energy Use (MM Btu)	35,174	37,366	39,227	31,988	**37,366**	**136,546**	38,622	38,622	38,622	38,622
Change	7.34%	19.69%	20.39%	9.12%	**14.81%**		9.80%	3.36%	-1.54%	20.74%
Energy Cost	$427,278	$499,812	$512,885	$415,380	**$1,854,355**	**$1,733,822**	$471,602	$471,602	$471,602	$471,602
Change	9.64%	21.61%	18.57%	7.09%	**14.39%**		10.37%	-5.64%	-8.05%	13.53%
Energy Cost per MM Btu	$12.15	$13.38	$13.07	$12.99	**$12.90**		$12.21	$12.21	$12.21	$12.21
World Class Rating										
World Class Energy Assessment Score[2]	90%	88%	91%	92%	**92%**	**85%**	92%	88%	75%	85%
Projects										
$ Value of Energy Projects Secured & Delivered	$6,990	$165	$165	$165	$7,485	**$74,174**	$12,729	$12,729	$12,729	$12,729
$ Value of Energy Projects Secured as a % of Plant Energy Spend[3]	1.6%	0.0%	0.0%	0.0%	0.4%	4%	2.7%	2.7%	2.7%	2.7%
$ of Projects Identified, Being Evaluated & Planned	$0	$0	$0	$12,729	$12,729		$0	$0	$0	$0

Source: www.reliableplant.com/Read/23192/3m-game-plan-energy-usage

Another trait that tends to lead to the tracking and optimizing of EI is when the energy cost is a large percentage of the manufacturing costs. An example of this aspect is with industrial air separation plants. With this industrial segment the material cost is free (intake air from the atmosphere) and labor is relatively lean with a few people in a control room. When energy costs are a smaller percentage of the recurring manufacturing costs, companies are more likely to focus on the higher costs such as material, maintenance, or labor and less likely to identify and optimize an EI. It is this market segment that could benefit most from utility technical support and incentives.

In addition to company size and proportional energy cost to other costs, there are several other inherent reasons that many facilities are not utilizing EI as a performance metric and optimizing the EI. Many facilities produce a variety of different materials. Separating out the energy costs for each product can prove to be difficult especially with auxiliary equipment that may serve multiple process lines. As indicated previously, many facilities have the information but the silo nature of corporations prevents communication. Production numbers are typically maintained at the plant but the utility bills may be paid at the corporate office. When an energy auditor asks the plant or maintenance manager for their utility information, it is not uncommon for the response to indicate that the plant personnel does not even see the utility bills and usage.

Implementing Energy Efficiency: A Holistic Approach

A holistic approach at an industrial facility maximizes plant operation efficiency, cost savings, and utility incentives. This holistic approach may involve changes to only one energy using system, but analyzes an EI to quantify the process or overall facility energy consumption per production unit. For plant personnel, the EI metric provides a means of comparing process line or facility efficiency over several years in an apples to apples manner where production levels vary. Because of this, the EI is extremely useful for evaluating the effectiveness of energy efficiency projects over time. Such improvements in evaluation of projects are what align the benefits of the industrial energy efficiency project with state and utility goals.

In order to promote the reduction of overall energy intensity in the industrial sector, several state and government programs are focusing on the EI metric. For instance, the California Energy Efficiency Strategic Plan (2011 update) identifies a goal to reduce the overall EI by 25% by the year 2020 [CPUC, 41]. The US Department of Energy (DoE) is also sponsoring the Southeastern Center for Industrial Energy Intensity Reduction (the Center) – a 3 year project that will drive to self-funding by the end of its term. The program targets industrial markets in Alabama, Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. The Center "aims to create partnerships among DoE, state and local government, universities, end users, utilities, and nongovernmental organizations (NGOs) to reduce energy intensity by 2.5 percent each year of the three-year project period regionally, or 7.5 percent overall" (US DoE MS, 1). New York has also instituted a program dedicated not only to energy efficiency but to lowering EI metrics as well. The overall goals of the Energy Efficiency Portfolio Standard in NY are to "reduce electricity and natural gas consumption by 15 percent by 2015 (*15 in 15*) through its Industrial and Process Efficiency Program" (US DoE NY, 1). This program, funded by the New York Public Service Commission, states that "the overall objectives of the New York team's plan are to accurately measure industrial energy and carbon intensity" (US DoE NY, 2). Because these programs are driving industrial markets to quantify and evaluate energy intensity, the overall EI of the Industrial Sector in the US has been dropping with increasing gross domestic product (GDP). Figure 2 below, provided by the US DoE, illustrates this trend.

Figure 2. Industrial Sector Intensity: Delivered Energy

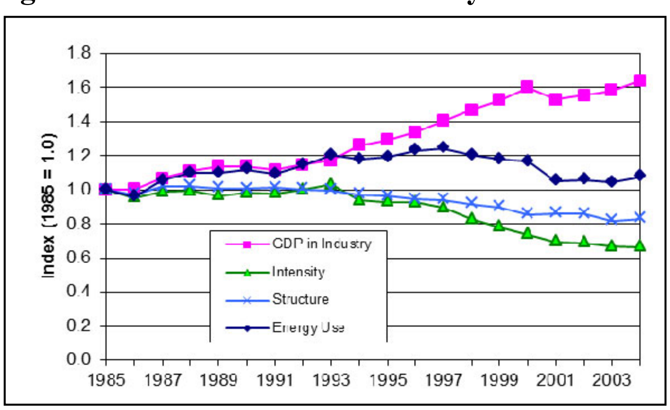


Figure source: http://www1.eere.energy.gov/analysis/eii_trend_data.html

The Energy Use line in Figure 2 pertains to delivered energy, which is the energy purchased by end users of the Industrial Sector and does not include fossil and renewable fuels consumed. The Structure trend line pertains to structural changes in the economy that are not related to energy efficiency improvements. Figure 2 indicates that since the 2000s, the Structure EI has dropped to about 0.8 of 1985 levels, which accounts for most of the drop (to about 0.65) in Energy Use reduction. Therefore, about 0.15 in 1985 index reduction for Energy Use can be attributed to energy efficiency improvements. Since this is a relatively low percentage, it is reasonable to conclude that this is due to single system and low hanging fruit such as lighting efficiency. This trend is consistent with the findings of the "Industrial energy efficiency for sustainable wealth creation" report by UNIDO:

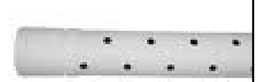
> Although energy use has been rising, industrial energy intensity has been declining in all regions and in countries at all levels of development, implying a gradual decoupling of industrial energy use and economic growth, though with considerable variation across regions and industries. Part of the reduction in industrial energy intensity results from government policy. Another important part is an outcome of technological progress, industrial restructuring and changes in fuel mix and production-oriented initiatives. (UNIDO, 23)

While the EI metric has shown improvement over the past 20 or so years, the reality is that many industrial segments do not track the energy metric per production unit as a common practice in their business. Thus, EI may not be considered when making production or facility improvements. Such practice is in direct contrast to state level strategic energy plans that focus on EI. In order to ensure the alignment of state, utility, and facility goals, the holistic facility approach with consideration of EI is recommended. Additionally, the CPUC notes that utility programs parameters can lead to a lack of recognition of savings from process or operational savings [CPUC, 41] which can be alleviated with a holistic EI approach. The following sections outline a real world case study where the holistic approach was adopted and implemented to yield significant energy savings.

Case Study with Energy Intensity

A cooling system retrofit was implemented at a plastic manufacturing plant and the overall energy savings were evaluated based on EI. This provided the most accurate account of the actual energy savings due to the nature of the plant and the impacts from the retrofit. Additionally, the EI approach allowed for an assessment of the overall energy savings in relation to the actual production which included a production increase.

Bender Boards


Perforated Pipe

The facility operates 24/7 year round with the exception of some maintenance operations and holidays. The facility makes primarily two types of products for irrigation and landscaping. These are "bender boards" and "perforated pipe". To produce these products, plastic material is ground and extruded into the final product. This process requires energy from extruders, compressed air systems, vacuum pumps, and cooling equipment. The proper cooling is critical in the overall product quality and saleable product. Line speeds are optimized to maximize production while minimizing the unsalable product or "scrap" material. Since the product must go through the entire process before being categorized as salable or scrap, scrap material consumes the same amount of energy with no product benefit.

Case Study with Energy Intensity: Existing System and Issues

The plant had evolved as typical for industrial plants. Process lines had been added throughout the years and cooling equipment added on an "as needed" basis to serve the individual lines. Cooling of the product was provided by chilled water, cooling tower water, and small blowers. In general, as process lines were added, cooling equipment was also added with dedication to a single process line. The chilled water piping was 2" in diameter. Table 1 provides a summary of the existing cooling equipment and design and operation issues. Figures 3, 4, and 5 illustrate the general configuration of the cooling systems.

Table 1. Summary of Existing System Design and Operation Issues

Equipment	Description	Design/Operation Issues
Six Chillers	A wide variety of equipment types ranged in capacity from 20-50 tons. These included a combination of air-cooled and water-cooled as well as scroll and reciprocating compressors.	The dedicated chillers for each line are an inefficient method of providing cooling due to multiple chillers operating at part load and air-cooled condensers.
Chilled Water Pumps (CHWP)	Since each process line had a dedicated chiller system, individual chilled water pumps were required. Several booster pumps were added to each system over time to try to improve the cooling of the product.	Despite the booster pumps, the system was unable to provide enough cooling to the process. However, the issue was the pipe size and not the pump capacity.
Cooling Towers	Two cooling towers provided heat rejection for the water cooled chillers as well as miscellaneous process loads in the plant.	The cooling towers lacked the overall effectiveness. Combined with the pipe size, the water temperatures would increase and in hot summers the towers could not keep up.
Condenser Water Pumps (CWP)	Condenser water pumps were located above a pit providing water to the plant and returning it to the towers.	The pumps lacked adequate net positive suction head (NPSH) which result in inefficient pumping.

Figure 3. General Configuration of Existing Air-Cooled Chilled Water System

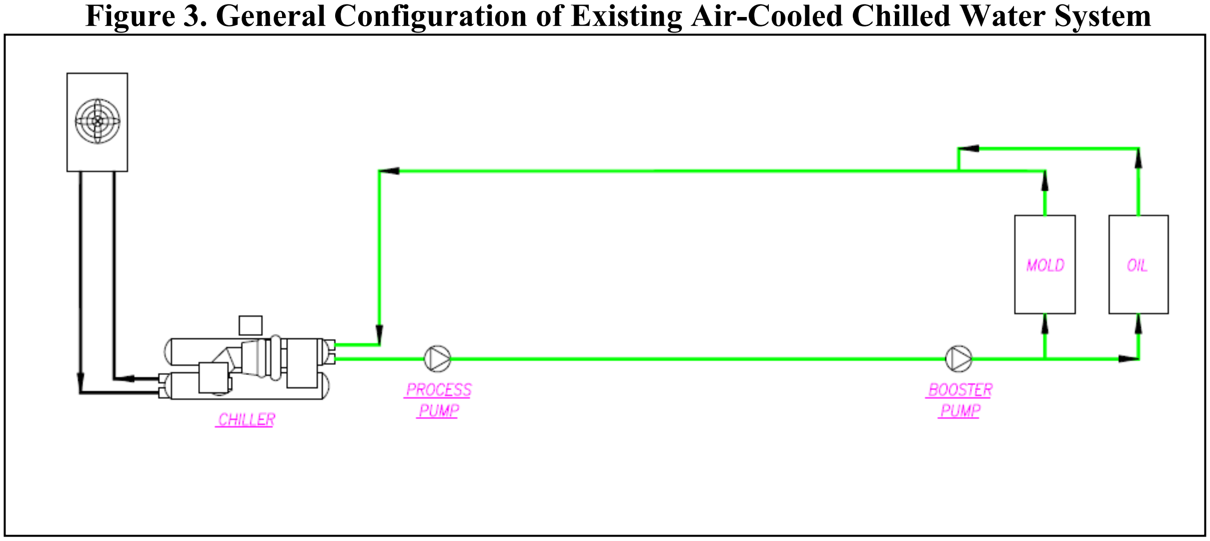


Figure 4. General Configuration of Existing Water-Cooled Chilled Water System

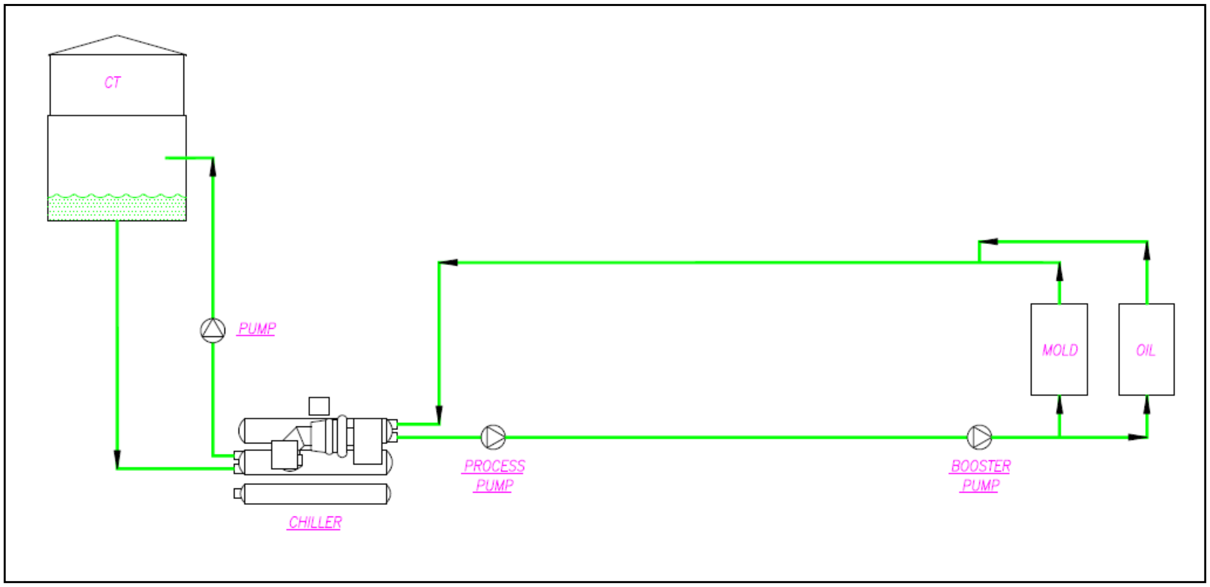
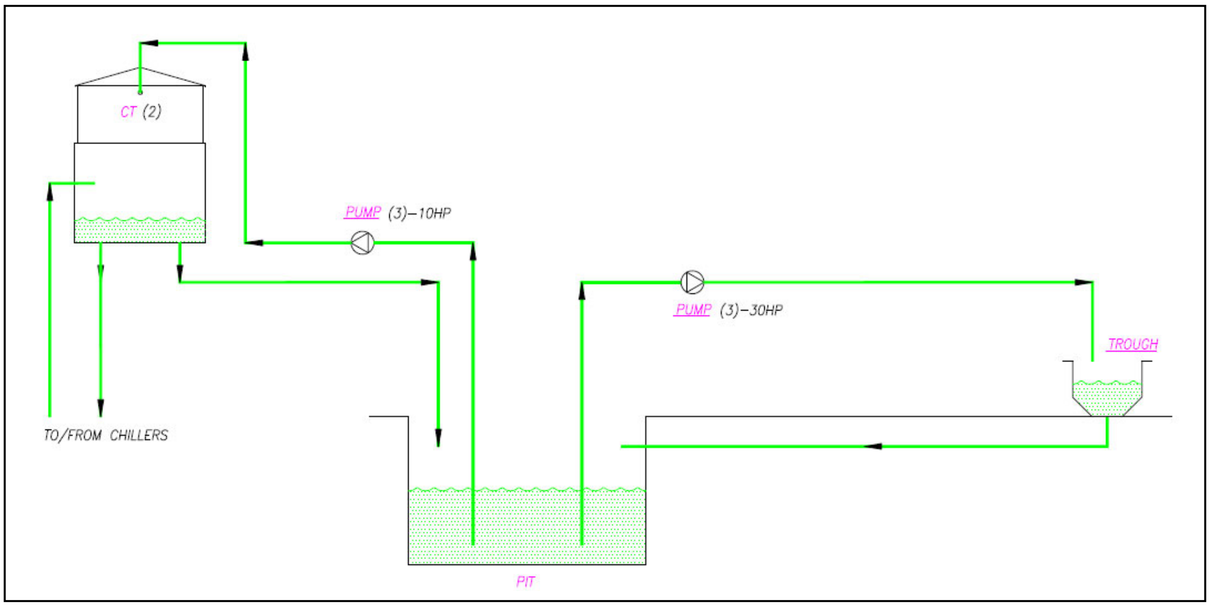
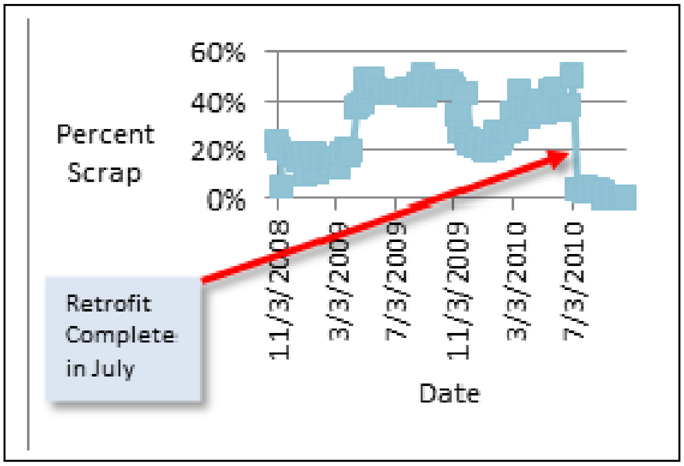


Figure 5. General Configuration of Existing Condenser Water System



With the existing configuration, the production of the plant was not optimized. As the weather warmed up in the spring and summer, the system would lose the ability to cool the product properly. The result was a high percentage (some weeks as high as 50%) of the product was deemed unsalable. The bender boards were not being cooled at the proper rate and resulted in a "dog bone" effect on the product. Similarly, for the perforated pipe, the product was at too high of a temperature when the holes were generated which resulted in asymmetrical holes in the product. Both of these conditions resulted in scrap material that was reground and reprocessed. Thus, each scrap material required the same start to finish energy input as salable material.

Figure 6: Percent Scrap Over Time



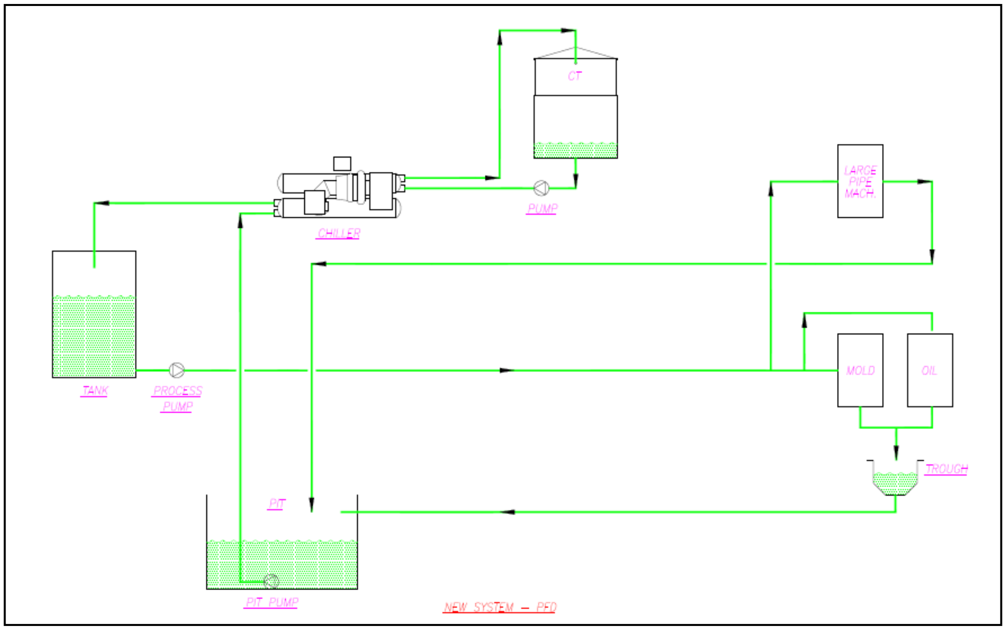
Case Study with Energy Intensity: Retrofit System and Solutions

The retrofit involved a new centralized chiller system including a new cooling tower, pumps and a chilled water storage tank. Additionally, reconfiguration and repiping of the chilled water distribution system was completed to optimize the cooling. As illustrated in Figure 6 above, the new system eliminated almost all scrap even on the hottest day of the year. Additionally, line speeds increased by approximately 25% due to the ability to deliver more cooling to the process. Table 2 provides a summary of the retrofit system and system efficiencies.

Table 2. Summary of Retrofit System and System Efficiencies

Equipment	Description	Efficiency Component
Chillers	A single 200 ton water-cooled chiller with a VSD.	The VSD controlled central chiller provides efficiency part-load performance.
Chilled Water Pumps (CHWP)	The cooling system was repiped with 6" pipe and reconfigured. A raised chilled water storage tank was installed. New pumps were installed sized for the central system.	The larger pipe diameter allows for the flow of water without cavitation. The raised storage tank provides sufficient NPSH. VSDs were added.
Cooling Towers	Over-sized and raised cooling tower with VSDs on the tower fans were installed.	The raised tower provides sufficient NPSH for the CWPs and the VSDs on the fans optimize energy consumption during part load conditions.

Figure 7. General Configuration of Retrofit Plant Cooling System

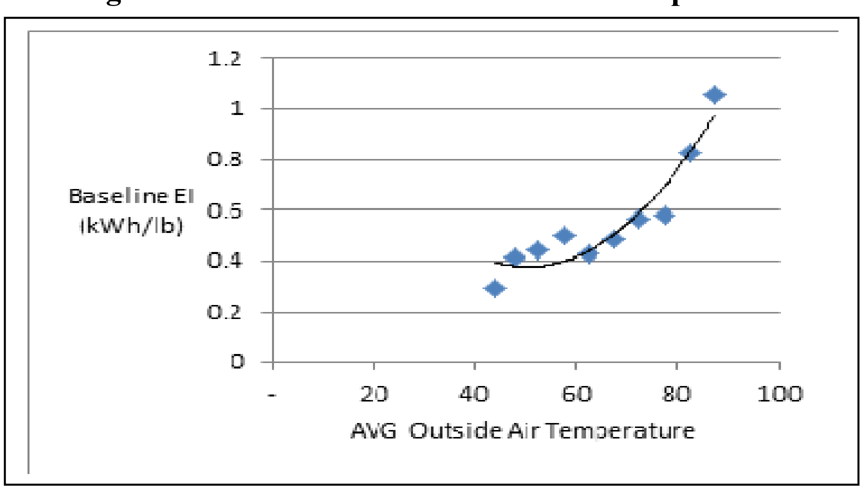


Case Study with Energy Intensity: Calculations and Energy Savings

The retrofit system provided not only an efficiency benefit over the existing system but also an overall facility wide EI benefit. The individual equipment provided typical energy savings in many ways. However, the increase in production which coincides with the overall EI improvement is the real benefit to the industrial facility.

Facility utility meter data was used in order to capture the entire plant's consumption including the auxiliary equipment, grinders, extruders, air compressors, and vacuum pumps, that were not involved in the retrofit but impact the facilities overall EI expressed in kWh/lb. Since the percent scrap and coinciding salable production is weather dependent, the baseline EI is also weather dependent. A trend analysis was performed to evaluate the relationship between EI and outdoor air temperature. This relationship, based on eighty eight (88) weeks of data, was used with average outdoor air temperature from a local weather station. When compared with typical year weather, the resulting average EI for the year was 0.58 kWh/lb.

Figure 8. Baseline EI with Outside Air Temperature



Fifteen (15) weeks of data after installation was collected to verify the retrofit EI and energy consumption. This data set included the hot summer months and the resulting scrap rate in the 0.5-2% range with an average of 1.6%. The EI during the retrofit period was essentially flat and the lack of dependency to ambient weather conditions indicates the direct impact of the project. The average retrofit EI was determined to be 0.31 kWh/lb which is a 47% reduction.

As stated earlier, States and government organizations promote and maintain goals for the reduction in energy consumption per salable product. Thus, for that purpose, the overall retrofit production (P_{Post}) values can be used to estimate the energy savings for the project. This provides the energy savings that occur if the existing system had provided the retrofit production. Utilizing the post installation production for projects that increase the production is important to align with the State goals relating to EI as a function of Gross State Product.

$$kWh_{Saved} = (EI_{Base} - EI_{Post})(P_{Post})$$

Using this equation, the overall societal benefit in energy savings of this project is 8,225,366 kWh. In comparison, the single system energy savings on the chiller, cooling tower, and pumps resulted in an energy savings of 1,340,020 kWh.

Conclusion

Industrial facilities are unique entities that have unique challenges. Grouping energy efficiency programs from all market segments (i.e., commercial, agricultural and manufacturing) under a common set of policy objectives and requirements imposes potential problems related to program design, implementation, and evaluation. For exampling minimum efficiency requirements for commercial buildings (e.g., California’s Title 24) limit the incentive to cover part (e.g., 50%) of the cost of replacement existing HVAC equipment that has reached the end of its effective useful life, with premium efficiency HVAC equipment that exceeds minimum efficiency requirements mandated by the State. This is similar to offering a 10% rebate for an Energy Star refrigerator. The means of estimating, verifying and incentivizing these types of “equipment efficiency” improvements are well documented and are often relatively easily implemented. As was demonstrated in this case study, applying this one-for-one replacement approach to manufacturing projects challenges and blurs the intent and definition of many program goals and participation requirements as well as impacting the overall claimed savings.

The current model for energy efficiency programs is incompatible with the Industrial sector. General rules and guidelines as they are written often deviate from the intention/spirit of energy efficiency programs. Helping manufacturing companies solve problems and increase profits through energy efficiency measures should be supported by State and Utility policies. Applying blanket statements related to minimum efficiency requirements, industry standard practice, net-to-gross ratios and overall economic benefits is burdensome, bureaucratic, and costly for all parties involved. Establishing metrics and goals specific to the manufacturing sector(s) should offer flexibility and efficiency in delivering energy efficiency support and incentives as well as serving this customer base by fully supporting their initiatives. This approach is currently being sacrificed for the sake of consistency across market segments, which is more of an accounting and political issue than an effective programmatic and engineering decision. Market segments are not consistent and the application of incentives is not currently being fully optimized.

Designing programs for specific market segments (i.e., manufacturing) will enable program designers, implementers and evaluators to more effectively meet the needs of the customer, target specific program objectives and assess full benefits of incentivizing industrial energy efficiency projects (i.e., lower energy intensity (kWh/widget), related reductions in GHG or other local air quality improvements, improved labor market, global competitiveness, etc.). In the past being efficient meant not having to build a new power plant. Now energy efficiency means much more such as conserving natural resources for future generations, mitigating against the impact of global warming, becoming energy independent, realizing a competitive advantage on the global market to maintain or bring back manufacturing jobs in the United States.

Aligning utility programs with facilities' goals to produce more widgets at a lower cost will ultimately allow for a more successful, holistic approach to energy efficiency as well as quantify the actual energy savings of the process related projects. Additionally, utility energy engineers and subject matter experts can influence the facilities in analyzing this metric for their benefit. While this certainly will be a challenge for some industries with multiple product types and a lack of sub-metering available to dissect the energy consumption, in many industries the information is available but is not used.

The Industrial market segment provides a great opportunity for overall energy savings for utilities. However, future energy efficiency program designs need to consider the overall impacts of the retrofits and account for the energy savings accordingly. With many industrial projects, EI is a mechanism to accurately evaluate the societal realized savings. The cost effectiveness of these programs is measured based on a ratio of the overall benefit to the cost. For Industrially focused programs, the true benefits should be considered in the energy savings.

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