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GMP Food & Beverage

Sustainability in the GMP Industry

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Though resource conservation has been a topic in the GMP industry for a number of years, the idea of a broad commitment to sustainable construction and operations has only recently begun to be woven into the GMP dialogue. Buildings have a large impact on the environment and on public health, and the utilities they use can affect the corporate bottom line significantly. Designing facilities that are resource conscious, energy efficient, and mindful of healthy environments can reduce a corporation's carbon footprint and increase profits. Industry sectors such as corporate workplaces understand and leverage these strategies routinely; yet to date, GMP facilities have barely scratched the surface of their sustainable potential. However, a definitive shift is underway in the GMP industry's understanding of how to apply and implement successful sustainability programs for economic and environmental benefit.

ECONOMIC, ENVIRONMENTAL AND SOCIAL ASPECTS OF SUSTAINABILITY

In recent years, the practice of incorporating sustainable design initiatives has become more important for companies interested in limiting the short and long-term environmental impact of their facilities and their operations. Sustainability measures can help create a facility that is both less expensive to operate and more productive, reducing the amount of product lost to the waste stream, recapturing and reusing gray water for other purposes, etc. A sustainable facility may also reduce negative consequences to the local utilities by reducing wastewater, storm water, and energy demand.

Even as companies discover the environmental benefits of sustainability, they may be gaining other benefits too. Studies show when employees work in a healthy, high-quality indoor environment – one which features improved air quality, reduced noise, and increased access to natural light – productivity grows, and sick days are reduced. Such gains, in turn, may easily offset the costs of implementing sustainable features and operational practices. Sustainability is also good for public and employee relations: A strong corporate commitment to sustainable manufacturing practices offers opportunities to improve public perception and goodwill, while at the same time strengthening employee attraction and retention.

Furthermore, as governments adopt sustainable building practices, incentives at the federal, state, and local level may be available to help offset costs associated with implementing sustainability initiatives. From sales tax exemptions, income tax credits, low-interest financing and other incentives, a number of programs are available for adopting the use of alternative energy and fuels (e.g., solar, geothermal, wind, hydrogen, biomass), energy efficiency improvements, and other sustainable solutions.

Building codes are also playing a part. Exceptions in the energy codes used to exist for manufacturing facilities, but those have been mostly eliminated. Furthermore, as building standards which feature sustainability are adopted as building codes, they are driving sustainable design and construction practices. For example, the International Green Construction Code and CalGreen enforce specific sustainability standards in facility design and construction. ASHRAE 90.1 and the International Energy Conservation Code are regularly updated to more stringently regulate building energy consumption. At the same time, sustainability standards such as LEED – originally intended for commercial office buildings and similar structures – are beginning to acknowledge the tremendous opportunities and unique realities of sustainability faced by GMP facilities.

Just The Facts

According to the U.S. Environmental Protection Agency, 100 million tons of building-related construction and demolition debris are sent to landfills in the United States each year, with construction and demolition debris comprising about 40% of the solid waste stream. Between 2000 and 2030, an estimated 27% of existing buildings will be replaced, and 50% of the total building stock will be constructed.

MAKING THE BUSINESS CASE FOR SUSTAINABILITY

From an economic, environmental, and social standpoint, sustainability makes sense, but how does a GMP facility do more than just talk about it? As in any industry that attempts to adopt more sustainable practices, success for GMP facilities means taking a realistic, long-term, and corporate-wide view. For a company to begin implementing sustainability practices it must:

- Reduce waste, risks and costs.
- Re-design products, processes and functions to optimize performance.
- Align appropriate sustainable targets and initiatives with the company's business goals and mission statement. Fulfillment of sustainable goals often requires a cultural change that starts at the top and works its way through the organization. From the CEO down to employees on the plant floor, everyone must understand the sustainable mission and ensure that it is consistently implemented on a daily basis.
- Change the culture to align with core company values. Educate all associates so they understand and employ "best practices" in their job.
- Measure the value of any sustainability initiative by its "P3" impacts: Profit (economic), Planet (green, carbon) and People (societal). Remember that sustainability at any price is not truly sustainable, i.e., sustainability has to make sense economically, socially and environmentally.
- Communicate wins throughout the company. Success breeds success. As sustainable elements and measures are undertaken and change is seen, make sure that all employees are made aware of those successes.
- Take a longer-term view. Assess ROI and other success metrics for specific strategies with a three to five-year payback and with realistic consideration for future utility costs.

Hixson has found that when facility teams and corporate management emphasize energy efficiency as a part of the culture of the organization, savings – and success – frequently follow. For example, in one facility with which Hixson has worked, the company changed its practices to align with the sustainability initiatives it put into place. A post-project evaluation showed that the facility now saves approximately $1.3 million in energy costs annually, with payback occurring in just over one year. Such savings often offset the initial capital investments made and help make the project feasible to undertake.

THE SUSTAINABLE CHECKLIST: SUSTAINABLE OPPORTUNITIES FOR GMP PLANTS

To aid in the design process, Hixson created a sustainable design checklist to help take a comprehensive look at a building and the project to find design opportunities that can improve sustainability. These design opportunities then undergo an integrated design viability assessment that examines their ease of implementation, potential affordability, the desirable payback of the design solution, and the overall impact the solution will have on the project. Once the assessment is complete, one of four recommended courses of action are suggested: 1) Do not include, 2) include in base scope, 3) include as an adoption, or 4) further study is required. Below is a list of the possible sustainable design solutions included in this checklist that could make sense both economically and sustainably for GMP facilities, and which are generally incorporated as normal considerations within Hixson's base scope of design:

- **General**: Hixson's designs seek to use materials that have the least amount of negative impact on the environment and are conscious of the amount of energy that is required to make and install these materials in the built environment. The idea of sustainability, or ecological design, is to ensure that the actions and decisions of today do not inhibit the opportunities of future generations. For example, Hixson's base scope calls for the following:
  - Use low-Volatile Organic Compound (VOC) paints and coatings.
  - Measure energy usage both before and after implementation of a sustainable design initiative.
  - Institute the Best Management Practices (BMPs) such as those from the U.S. Department of Energy and the Association of Energy Engineers (AEE) for the operation of the basic energy-using infrastructure.
  - Consider roof systems that will reduce the heating/cooling loads on the mechanical building systems.
  - Use materials that are more sustainable.
- **Plumbing**: A sustainable plumbing design begins with a purpose-driven plumbing and utility design solution. Each space is evaluated on a room-by-room basis to ensure the correct sustainable design elements have been applied. To further drive down energy costs, using low-flow fixtures, and installing metering and sequencing control systems will greatly reduce the amount of energy required to run a facility. Hixson's base scope for plumbing includes the following:
  - Use dual-feed loops for the compressed air distribution system.
  - Use direct-fired water heaters.
  - Evaluate the use of an auxiliary receiver in areas with high instantaneous loads.
  - Use low-pressure loss compressed air system components.
  - Specify variable-speed motors for compressed air systems.
  - Use automatic drains at all compressed air condensate drains.

- Use refrigerated compressed air dryers where extremely low dew points are not required.
- Use automatic, low-flow faucets at sinks and low consumption toilets in restrooms.
- Minimize the use of potable water in cooling application.
- Use R/O or other water filtration technologies to reduce chemical consumption.

- **Mechanical**: Hixson's mechanical design typically includes solutions that make sense both economically and sustainably for our clients. Different solutions are also compared using energy modeling to determine the best fit for the specific project (e.g. variable refrigerant flow vs. air source heat pumps vs. water source heat pumps). Hixson's base scope for mechanical includes the following:
  - Maximize the condensate return in the steam system.
  - Use air-to-air heat exchangers (e.g. total enthalpy wheel and plate and frame heat exchangers) when using large amounts of outside air.
  - Specify variable speed motors (e.g., Variable Frequency Drive (VFD) or Electronically Commutated Motor (ECM)) for fans and pumps to ensure efficient operation at design flow requirements.
  - Optimize duct and pipe routing to reduce pressure drops created in the systems.
  - Insulate all pipes, valves and equipment to minimize heat loss.
  - Evaluate stack economizers for steam boiler designs.
  - Evaluate potential sources for heat recovery, such as compressed air oil coolers, ammonia system condensers, and boiler blow down.
  - Improve the thermal comfort without negatively impacting the environment.
  - Improve air quality both internally and externally to the plant and increase the effectiveness of ventilation systems.
  - Install high efficiency packaged rooftop HVAC units in small non-process applications.
  - Install programmable thermostats at all common use spaces.
  - Install equipment that best matches the steam load profile.

- **Electrical**: A sustainable electrical design begins with a purpose-driven lighting solution. Each space is modeled within a lighting design program. The fixtures are selected for lamp efficacy and luminaire efficiency to deliver the most efficient means of lighting the space. To further drive down energy costs, lighting controls are considered where spaces may be dimmed in association with daylight controls, step-dimmed in occupied modes to reduce lighting levels to 50%, or automatically shut off with occupancy sensors. Controls must complement the work activity and not create an unsafe working environment inadvertently. Lighting controls for interior and exterior lighting in conjunction with LED lighting sources offer the greatest energy savings opportunities in new and retrofit applications. Energy savings may also be derived through the careful monitoring of energy usage in the building. Hixson's base scope for electrical includes the following:
  - Install sub-metering for equipment and systems with heavy utility usage, e.g., bread ovens, steam boilers, hot water systems, large refrigeration systems.
  - Look at the baseline energy usage and monitoring programs to alert plant personal when energy usage exceeds norms. Improving

the visibility of utility usage and costs on the plant floor may enable end users to be more aware of how their actions can reduce energy usage.

- Evaluate the use of motion sensors or other automatic controls.
- Consider how daylighting will affect the lighting design and ways it can be harvested.
- Specify premium efficiency motors.
- Install transformers that are sized to operate efficiently at their anticipated load profile.

- **Manufacturing**: Hixson's manufacturing design parameters typically deal with sustainable opportunities related to processing and packaging equipment functionality. Examples include potential for reduction in packaging materials, any opportunities to reduce the amount of waste going to landfills (either packaging or product related), and optimization of startup and commissioning plans put into place to minimize resources and maximize output. Cube space is also analyzed to maximize storage opportunities as well as determine the most efficient rack storage types (e.g., pushback, flow through) for the processes. Analyzing bulk ingredient opportunities (e.g., corn syrup liquids vs. solids, bulk ingredients vs. totes, bulk sanitation chemicals) to save on the facility's square footage is also taken into consideration. Hixson's base scope for manufacturing includes the following:
  - Seek to commission equipment to minimize resources and maximize output. Reducing the resources required to support equipment by combining unit operations if possible.
  - Strive to rebuild/refurbish existing equipment, rather than purchasing new if possible.
  - Specify equipment designed and built sustainably.
  - Donate used equipment to an industry-related association, educational institution, research center or trade school.
  - Use laser coding where possible versus inkjet.
  - Standardization of equipment parts.
  - Specify high efficiency motors.
  - Use laser coding where possible versus inkjet.
  - Strive to minimize packaging, transportation, and resource recovery.
- **Refrigeration**: Ammonia refrigeration design strives to achieve the lowest discharge pressure and the highest suction pressure to reduce energy usage and the carbon footprint. Hixson's base scope for refrigeration includes the following:
  - Eliminate or reduce the use of or dependence on ozone-depleting substances such as HydroChloroFluoroCarbons (HCFCs).
  - Strive to have the highest suction temperature.
  - Provide a non-condensable purger to remove non-condensable gas from refrigerant.
  - Provide automatic controls to properly purge noncondensable gases.
  - Reduce the ammonia charge to the minimum required for the designed system.
  - Evaluate the use of air curtains at openings.
  - Specify VFDs to lower power consumption.
  - Install proper control sequencing on compressors to help meet variable demand and prevent full unloading.

INCREMENTAL STEPS FOR LONG-TERM GAIN

Sustainability will not happen overnight in GMP facilities; rather, it is a long-term investment. While beginning sustainable design initiatives can seem

daunting, the initiatives do not have to be undertaken on a grand scale to have an impact. Instead, many companies have found success simply through proven, incremental improvements. In fact, companies may already be meeting sustainability goals - perhaps without realizing it - by employing proven technological solutions having quick economic payback (generally within two-to-three years). More innovative initiatives, such as the use of cogeneration, must be investigated on a site-by-site basis to determine if the initial capital costs required will provide an acceptable payback and are feasible for the company's facilities. Many companies fear that implementing sustainable principles into their buildings will adversely affect their profits. Business owners contemplating how they can afford a sustainability strategy - and what the return on investment will be - may be best-served by taking a long-term approach. That includes identifying business priorities, looking at the big picture, and being flexible. With patience and careful planning, sustainability can be a viable path for GMP facilities.

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