



“10 Non-Negotiable Requirements of an EMS for Breweries”

SUMMARY

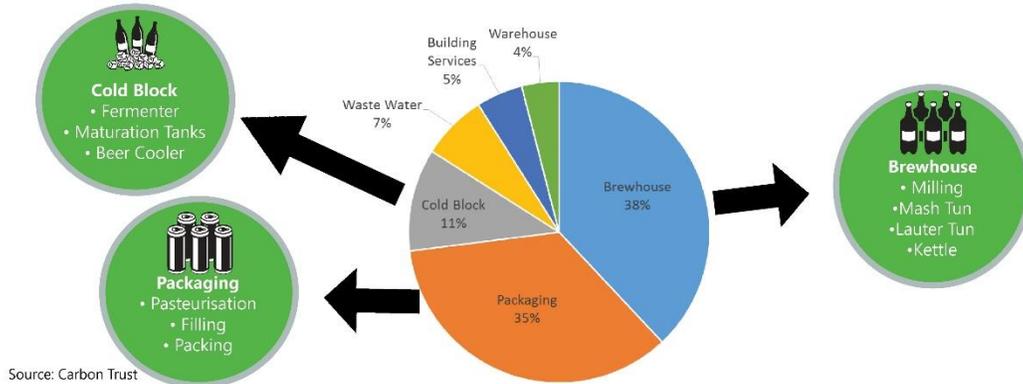
Targeting energy and water reductions represent a significant opportunity for breweries of all sizes. The costs associated with electricity, fuel, and water are often viewed as expenses that cannot be controlled, but in fact the potential utilities savings can be substantial. Brewery Energy Managers seeking to actively target these reductions require a full featured Energy Management System (EMS) that meets the advanced analytics needs of a brewing environment. While the global market of EMS's is growing every year, this paper lays out the requirements applicable to breweries that enable actual, measurable cost savings and carbon emission reductions.

INTRODUCTION

When selecting an EMS, a brewery energy manager is faced with the challenge of finding a solution that includes the wide range of functionality needed to target utilities reductions in a brewery. This paper explores the top key requirements that an energy manager should consider before purchasing. A brewing company's ability to set and achieve targeted savings is dependent on the availability of useful accurate measurements data and the analytical tools to find opportunities and measure savings. An EMS must do more than simply graph and report on water and energy spend, but rather it must enable proactive energy management, preventing waste before it has occurred.

A brewery's EMS must enable short interval overview of processes, providing views on targets at the hourly level, rolling up to daily, weekly, and monthly targets. These targets, set at different time periods are then also established at all levels within the brewery, from total brewery utility usages, down to the department and line totals, and finally down to individual equipment. This approach distributes the ownership of reductions across the entire operations team, by providing individuals at all levels in the organization with easy-to-understand information they can take action on.

Beyond the EMS product itself, it is equally important to consider the provider of the software. Many brewery energy managers face challenges in the implementation of an EMS, so being selective about the type of organization to partner with in introducing an EMS is important. Brewery energy managers should seek EMS vendors who specialize in partnering with breweries to introduce energy management systems.



1. Regression-Based Multi-Variable Targeting

Breweries utilize a variety of consumables and aren't simply limited to electricity, gas, and water, therefore a brewery energy manager needs an EMS that natively supports measuring and targeting of steam, CO₂ (collected and/or purchased), caustic, nitrogen, fuel oil, and others.

At the top of a brewery energy manager's EMS requirements list should be a built-in, comprehensive and easy to use functionality for managing linear regression models in order to set and manage consumption KPI targets. The software should enable energy managers to build regression models for predicting consumptions that factor in multiple input variables, such as packaging line volumes, brewing batch volumes, ambient air temperature, and more. Beyond basic production volumes and temperature, the modeling framework should enable selection of any type of variable, such as steam generated or CO₂ collected for targeting boiler and CO₂ recollection system efficiencies. Many EMS's will support regression modeling but the functionality will be rudimentary and only offer simplistic normalizing options, therefore requiring the use of an external tool such as Microsoft Excel for complex modeling. Beyond variables selection, the EMS must enable users to easily select, filter, and cull the model's driving time period. This enables proper selection of the data used to establish the model and accommodate the wide variety of factors that affect the correlations which change over time in a brewery. Changes in production volumes, product mix, production process flow, equipment replacement and maintenance, capital improvement projects, operating procedures, and many others can all affect energy efficiencies across a brewery. Therefore, it is imperative that the regression modeling tool is flexible enough to allow for this level of modeling in order to produce consumption targets that are reliable and can be trusted by employees who truly understand the nuances of the processes.

Energy performance targeting is best done in the form of KPIs in a manufacturing environment, and a top EMS will seamlessly integrate linear regression modeling with displaying consumption targets as KPIs. The goal is to enable energy managers to easily compare actual KPI values to targets, without

having to create time-consuming reports in Excel. The display of KPIs must be automatic and prevalent throughout the EMS reporting and analytics.

Short Interval Control

Targeting energy and water waste is best managed by setting shorter-interval targets. Monthly KPI targeting is useful for reporting past performance at a high level, but isn't the easiest to utilize to make quick, reactive changes. The most actionable information is that which is the most recent, so an EMS needs to be able to support linear regression models that can produce consumption targets and KPI targets at the daily, weekly, and monthly levels at least. While fluctuations increase as the time frame shrinks, it is possible to selectively choose areas within a brewery to set more granular targets – at the weekly and daily level.

2. Top-Down Reporting on KPIs

Metering plays an important part of an energy monitoring project in order to identify sources of waste. Having metering on departmental, line, and equipment level enables an energy manager to look back at usage trends to find problems. However, beyond simply trending data at these levels, really the most compelling case for installing sub-metering throughout a brewery is to enable benchmarking and establishing targets in these areas. Having an electricity KPI for the entire packaging department is good. Breaking that down further into electricity KPI targets for your canning and bottling lines is better. But having the ability to even target your pasteurizer or bottle washer's water consumptions with daily or even hourly targets is optimal. Presenting low-level daily or hourly KPI targets like these enable short-interval control over energy performance providing actionable information in a timely manner.

3. User Dashboards and Application Accessibility

In breweries, usually the individuals who have the greatest control over energy KPIs are those who are closest to the processes – working the packaging line, operating the kettles, managing the boiler room, etc. An important component of an energy management strategy is placing the usage trends data (and associated targets) in the hands of those who can influence the process the most. A top-tier EMS is able to present different views on the data based on the individual user, presenting information that is directly relevant to the user and meaningful such that action can be taken. These views are best



presented in the format of user-specific dashboards, as to prevent individuals from having to run (and potentially print) numerous reports in order to see the information they need. Ideally user dashboards should present actual usage against targeted levels, reflecting current conditions and providing a view back on recent time periods. Again, these specific needs will vary by the individual's responsibilities, so the configuration of dashboards must be flexible.

One common type of feedback from operators is that the information they need to view on a day to day basis extends beyond that of utilities consumption data. Brewing operators need views on the batches they're brewing. Packaging operators need to monitor filler efficiencies compared against rated. Boiler room engineers are monitoring boiler efficiencies as a top priority. While utilities management is intertwined with this information, it is rarely the context in which operators perform their duties. Thus having the ability to present EMS data alongside equipment efficiencies and production data is a huge selling point to many users. An energy management system must be able to not only import these types of data, but also must display and leverage it in ways that are intuitive and readily accessible. Furthermore, when certain types of information cannot simply be imported from one system into an EMS, consideration of how (specifically) a user will access their EMS dashboards is critical. The EMS application must lend itself to coexisting with MES and other production-orientated applications (SCADA for example) in terms of how users access the separate systems. Selecting a web-based EMS ensures the highest level of compatibility with other systems and accessibility to users with a wide range of computer experience.

4. Consumption, Financial Budgeting and Reporting

Brewery management teams familiar with brewery-level energy and water usage KPIs understand the important role these metrics play in reporting financial forecasts. Even without leveraging an EMS to produce financial costs data directly, forecasting energy and water consumptions can enable financial forecasting by understanding energy usage KPIs in conjunction with production forecasts. An EMS must support managing utilities consumption forecasts alongside production volume forecasts. Depending on a particular brewery's production schedule, these forecasts are most typically managed at the monthly or weekly level. Support for forecasted consumption, productions, and/or KPIs is required for managing static KPI targets across different departments, lines, and even certain equipment. Beyond support for forecasted productions, KPIs, and association consumptions, most EMS's will enable some of the same



types of analyses to be presented in terms of costs as well. Financial reporting on utilities is sometimes managed by disconnected teams of people (from Finance to Utilities to Energy Engineers, and even to Maintenance departments). Centralization of this information into an EMS makes good sense as it enables automated and consolidated reporting. Most EMS's may provide the ability to build simple unit cost rates to enable financial reporting on utilities, which would suffice for approximated trend reporting over time. A top-tier EMS should enable breweries to calculate the precise costs of their utilities based on the rate tariff structures charged by their utility companies. Selecting an EMS like this enables 100% accurate reporting on utilities costs, enabling a fully accurate means of calculating these and validating utility bills as they are received.

5. Exception-Based Alarming

With accurate and granular targets in place throughout a brewery, managing these targets is key. Active energy management takes the approach of proactively addressing high energy and water consumption as soon as they are detected. Exception-based alarming is a common approach when proactively monitoring any type of data and is common place in energy management as well. When selecting an EMS, an energy manager must consider the variety of triggers that are required to adequately capture exceptions to acceptable utilities usage. At the most simplistic level, static range alarms are used to define an acceptable range that meter readings must fall within. Exceeding the boundaries triggers an alarm. This approach is useful on meters that measure relatively predictable consumptions with low variation, however in a brewing environment utilities consumptions can vary vastly when comparing baseload consumptions to full-production consumptions. Regression-based alarming is far more reliable in these cases, whereby boundaries can be dynamically driven by one or more input variables (like production volumes and temperature). Simply put, the multi-variable linear regression models discussed previously in this paper should also be used for exception alarming. If an actual consumption exceeds the linear regression-predicted consumption by a specified percentage, then an alarm should raise. A good EMS should make this approach easily manageable for all of the targets established within a brewery.

In non-production areas (such as administrative, sales, and marketing offices), regression-based alarming isn't a sensible way of managing energy whereas schedule-based alarming is. An energy manager must be able to define schedules of activity within these spaces, and alarm of usage spikes that don't follow schedules or predefined usage profiles.

6. Corporate / Public Dashboards

As with most organizations, brewing companies face challenges of communicating their energy initiatives and the progress being made against them. From a public relations perspective this is both a challenge and an opportunity. From a standpoint of building buy-in within the company, an energy manager faces challenges in employee awareness, company culture, and potentially operator resistance to change. Energy and water reduction can be seen as unimportant, due to perceived low utilities costs or unfavorable ROI timelines with energy saving projects. These perceptions rarely match reality once holistic costs are quantified, and energy managers are often seeking ways to propagate the facts throughout the populations.



Corporate and public-facing dashboards are commonly understood to be an excellent way of addressing these challenges, both internally and to the general public. However, the dashboards software market is saturated with specialist companies claiming to be able to address the aforementioned challenges, and do so in a way that is engaging and digestible. The reality is there are few software products on the market that can readily import/consume utilities consumption and performance metrics data, and display it in a way that is relevant to the brewing industry. There are even fewer software products available that can do this without requiring steep customization costs, effectively binding the consumer to the software manufacturer to make even the simplest of changes to the dashboard. A brewery energy manager should seek to find a configurable, integrated dashboard solution that easily addresses the data integration and data presentation challenges “out of the box” without customization. These dashboards should present energy consumption and KPI trends in the context of brewing, alongside the brewery’s corporate messaging surrounding their energy initiatives. An effective dashboard will convey utilities savings in a way that is meaningful and impactful to a person that does not have an energy background.

7. Project Tracking and ROI Reporting

Having the right tools to analyze and report on utilities consumptions and savings is the top requirement for energy managers, however often determining how to go about finding savings in the first place can be a huge challenge. Brewing companies set corporate energy policies to reduce energy, water, and waste by a certain amount over a period of time. Translating this objective into actions is the objective of energy managers. Brewery energy managers are presented with a wide variety of cost-saving opportunities to consider ranging from equipment upgrades such as boiler retrofits / replacements, introducing or improving CO₂ reclamation, to process and purchasing improvements such as tuning line startup and shutdown procedures and evaluating different energy purchasing options. The maths involved in calculating long term expenses, savings, and ROI can be very cumbersome to perform for each and every project. Energy managers often create complex spreadsheets from scratch to aid in this process. This process is time consuming and prone to error and is simply unnecessary when an EMS can do this analysis automatically.



The EMS is best positioned for this analysis given that all utilities consumption and cost data should already be captured in the system. When selecting an EMS a brewery energy manager should seek one that;

- contains functionality to establish the high-level objectives of saving energy, water, waste/effluent, CO₂ emissions and / or costs,
- evaluate various opportunities against different criteria, track progress made on projects that move forward,
- and ultimately verify whether savings have been realized and whether the company is on track according to the energy objectives.

Oftentimes there are a large number of opportunities that need to be pursued in order to uncover the targeted level of savings. Many of these aren't easily quantified but require periods of study and evaluation in order to measure and quantify improvements. For example, scheduling changes represent a significant opportunity in both packaging and brewing, particularly to breweries that produce a large number of brands requiring frequent changeovers. Brewery energy managers understand that the specific types of beer being brewed also impacts energy usage. Brews with higher sugar content such as

iders require more cleaning. Packaging line switchovers are time-consuming and so scheduling optimization must be balanced with shipping demand. For multi-brewery companies, some of these challenges must be evaluated at the supply chain level rather than at an individual brewery level to determine which locations are best situated to brew and/or package particular brands, based on the equipment available at each location. These nuanced considerations are difficult to evaluate, but a top-tier EMS will enable energy managers to capture this information, make informed decisions and feedback to the relevant departments about the effects on energy

Monitoring a brewery's path towards an energy policy target also represents a challenge. Uncovering savings year over year is difficult, especially after the largest low-hanging fruit have been addressed. Changes in production volumes can add further difficulty to achieve targets, especially non-normalized targets. An EMS that tracks projects should also provide tracking, helping energy managers determine whether they are on track each year to achieve their targeted savings or whether additional opportunities need to be implemented.

8. Custom Reporting and Data Export

While most breweries will share the same general energy management approaches and techniques, each brewing company operates differently and thus would have its own detailed requirements of an EMS. Differences in organization structure, resources involved in energy management, reporting requirements, and company-specific terminology and culture collectively contribute to a need for customization in their selected EMS – as would be the case with any system deeply integrated into business processes. Reporting requirements are driven by the audiences consuming the information. In one organization the Finance department may need to directly receive forecasted energy consumptions (calculated using production forecasts), and they may need this information every month to produce financial latest estimates on P&L. Rather than have an energy manager calculate these values in a spreadsheet and email the finance users, an EMS should be able to generate and email this report directly to the finance users. Another scenario may be that a brewery already uses a third-party tool for calculating savings glide paths and needs to export forecasted consumptions from the EMS for importing to the tool. If this tool is deeply embedded into business processes, then the EMS may need to produce a data export in a specific format to work with the tool.

These scenarios point to a need for customizable reporting and data exporting, to fill the need where energy usage, targets, and savings must be presented in a way consistent with existing reporting within the organization.

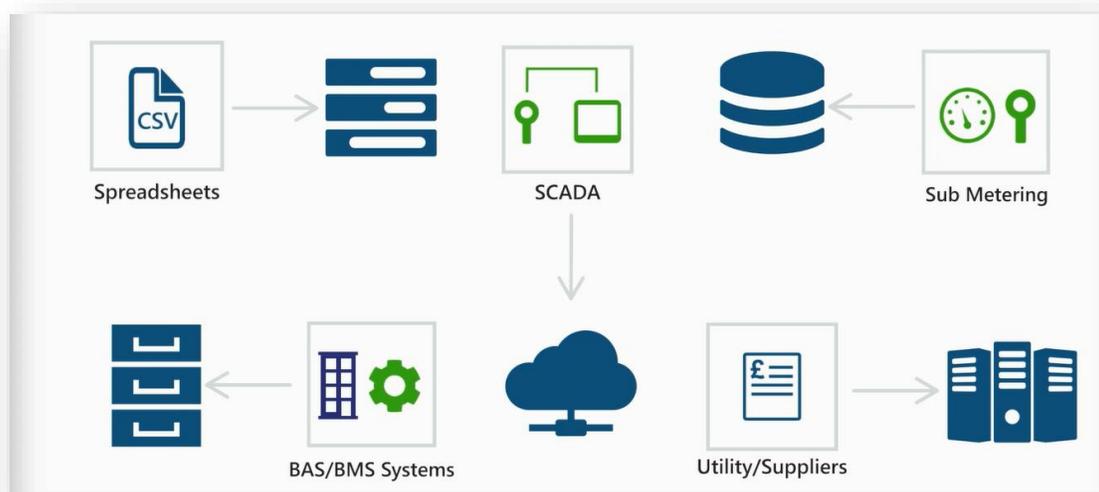
There are several standard report design platforms on the market and each EMS will either leverage one of these or a proprietary built-in reporting framework. Most individuals who have implemented complex systems like an EMS would agree that a standard reporting framework is the best route as it is more likely that someone in the organization has experience developing reports in the given framework. An EMS should leverage a standard reporting framework and make its data available to the reporting framework via a library of data access methods. While the report writer must have technical expertise with the reporting framework, they should not have to be an expert in the EMS's database in order to create customized reports.

Whether brewery energy managers require custom reporting to present a specific set of data to certain users or simply need to overlay the brewery's own corporate messaging and theming, an EMS must be

able to support these scenarios to fill any specific reporting gaps. A quality EMS will address most reporting needs out of the box, but customization is always a likely need.

9. Integration

Energy Management Systems are becoming increasingly prevalent on the market, largely due to the fact that non-specialist companies are adding energy management functionality to their core product offerings. This is common practice among providers of BAS / BMS, metering & data loggers, and even larger ERP solutions. These solutions offer rudimentary graphing (and potentially targeting) capabilities but sacrifice in-depth analytics, verification, and savings calculations. The main selling point of these solutions is typically that of a perceived ease of integration (or even automatic / “built-in” integration). While this is an effective marketing tactic, the technology underneath is rarely consistent with the claim.



For brewery energy managers, this is often the case presented by their MES provider. A brewery must have a manufacturing system managing the brewing and packaging of their products, therefore it is logical to look for an EMS solution from this provider. While integrating utilities and production data into the EMS is obviously a necessity, the fact is that data integration is a very small component of what is required of an EMS (as this paper intends to convey), and that a top-tier standalone EMS will support the industry standard protocols likely used by their SCADA and MES systems anyway. The OPC standard, for example, is supported by nearly every contender in the brewery EMS market. Several companies exist solely to integrate systems like MES to other software platforms via OPC. Due to the simple data format of metering data, there are numerous routes that can be explored when considering data integration. Many EMS providers even offer an integration platform as part of their product suite to further address this. On the other hand, some software companies that do not specialize in EMS’s will charge exorbitant integration fees to connect to systems that are not their own.

Successful integration to a brewery’s existing metering and production systems should definitely be a requirement when an energy manager is selecting an EMS, but should not be the starting point or the main driver. The functional needs of an EMS are far larger.

10. An Effective EMS Partner

When evaluating any large software product to incorporate into an organization's business processes, the buyer is effectively evaluating two separate entities: the software product itself and the company that provides the software. In addition to the list of software functionality requirements, an energy manager must gauge whether the company itself is a group of individuals that will bring value to the energy management program as a whole. This categorically takes two forms.

1. The vendor's willingness and ability to provide a fully integrated and fully configured solution.
2. The vendor's ability to participate in change management and adapting business processes to support the EMS.

As discussed in this paper, implementing an EMS at a brewery is an undertaking that requires planning, time, and effort. Many organizations' energy managers face serious time constraints operating as a single-person team or part of a very small team, as energy management represents a relatively small focus in the organization. This is particularly the case in breweries as many breweries either don't have a dedicated energy manager or when a dedicated person exists, they are often spread thin across an unmanageably large area of responsibility. Implementing an effective energy management program – leveraging an EMS, requires time investment that most brewery energy managers don't have. Therefore, it is of utmost importance that the EMS provider is able and willing to truly partner with the brewing company, understanding their particular business, and providing real solutions. From a technology stance, this includes things like the need to integrate data connections and configure the software itself. Also how receptive the vendor is with product feedback and customization requests is an important consideration.

Beyond the technology and functional needs, the requirements of a good EMS partner also extend into soft needs such as helping the energy manager develop communications and engagement strategies within the brewery. Employee engagement and change management is arguably the most difficult aspect of implementing an EMS for breweries. There are aspects of organizational culture that make this difficult. Brewing is a resource-intensive process. A lot of water goes into making beer, and most of it never makes it into the bottle. This is evident to anyone who has ever walked a brewery. It is also a very energy-intensive process. A lot of heating and cooling are required in the processes. Most businesses aren't accustomed to having such a real-time view on how they are performing, so taking a proactive approach to energy and water reduction is often a huge culture shift. In breweries simply introducing real-time utilities tracking will reveal waste due to things like faulty valves, leaking pipes, improper PLC programming, or non-compliance to standard operation procedures. These wastes can accumulate to significant losses over time and are therefore a good starting place to communicate the benefits of real-time tracking using an EMS.

In some organizations this energy and water use is seen as largely uncontrollable and employees don't see opportunities for improving the processes. In some areas of the world the cost of utilities is relatively low, so the benefits of energy savings initiatives are a harder sell. Building employee engagement and buy-in is absolutely necessary in these environments as again, often the individuals who have the greatest day to day influence over utilities usage are those who are closest to the processes.

Selecting a true partner in implementing an EMS is of utmost importance. Brewery energy managers should seek vendors that not only produce an EMS that satisfies their functional requirements, but also is the type of company that can add value to their energy management program as a whole.

Conclusions

Brewery energy managers face a difficult task when selecting an Energy Management System. The list of functional requirements is long, as there is a lot of tangible value an EMS can provide to an organization through its capabilities. Selecting an EMS and an EMS provider that cover these key requirements is critical in achieving measurable success against utilities savings goals.