Getting Value from Your Industry's ENERGY STAR® Plant Energy Performance Indicator (EPI)

The ENERGY STAR Plant Energy Performance Indicator (EPI)

If you're reading this guide, chances are your industry has been provided an ENERGY STAR plant EPI to help you evaluate your plant's energy performance. EPIs are sector-specific benchmarking tools that enable energy managers to determine how efficiently a plant uses energy compared to similar plants in its industry.

The ENERGY STAR program develops EPIs to help manufacturing industries measure and benchmark plant performance, evaluate potential energy improvement opportunities and their impact on plant performance, set informed and transformative performance improvement goals, and assess changes in plant performance over time.

As of 2024, 20 EPIs have been released to a variety of industries, and more are in development. These benchmarking tools cover industries as diverse as cement production, integrated steel mills, and commercial bread and roll bakeries. To view the full list of EPIs available to industry, go to www.energystar.gov/epis.

This guide will help you leverage the EPI for maximum impact on managing your energy-savings efforts.

An EPI's Value at a Glance

An ENERGY STAR EPI is a management tool that helps measure the efficiency gap between average and top performers in a specific industry. It informs meaningful goal setting and enables simple scenario analysis for evaluating potential plant upgrades and projects. It can also be integrated with other key performance indicators (KPIs) to provide an early warning if performance is slipping or help assess projects' performance.

How Your EPI Was Developed

Since 2006, the ENERGY STAR program has been making it easier for manufacturers to benchmark, or compare, the energy performance of their plants to similar plants in their industry using the EPI. The ENERGY STAR program builds EPIs by working directly with energy managers in the companies within a specific manufacturing industry (e.g., cement or commercial baking). Through these collaborations, the ENERGY STAR team discusses development of the tool and provides industry experts the opportunity to review and test the EPI as it is developed. The final tool is released once industry feedback has been addressed and the EPI is performing as designed.

EPIs are built from data that include actual operational data from plants within a manufacturing industry: measures of plant production, energy inputs, and other factors that affect energy consumption. Data sources may include confidential industry data from the Economic Census, the Manufacturing Energy Consumption Survey, and other industry-reported sources. Each EPI is unique to an industry; thus, data sources are also unique to that industry.

What the EPI Measures

Simply put, the EPI measures the energy efficiency of a plant relative to similar plants. It answers the question, "if all plants in this industry operated as my plant does, except for energy use, where would my plant's energy use rank compared to everyone else?"

EPIs provide this information by calculating the plant's ENERGY STAR score on a scale of 1 to 100. The ENERGY STAR score (also referred to as an "energy performance score") shows what superior, average, and below-average energy performance looks like for a given plant. An ENERGY STAR score below 50 is considered below average, while an ENERGY STAR score above 50 is above average. To recognize the best-performing plants in an industry, the U.S. Environmental Protection Agency (U.S. EPA) defines an ENERGY STAR score of 75 as "efficient" energy performance, which qualifies a plant for ENERGY STAR certification (detailed later in this document). The ENERGY STAR score is a percentile-based score. For example, a plant's score of 60 would signify that this plant's energy performance is better than 59% of similar plants in the industry.

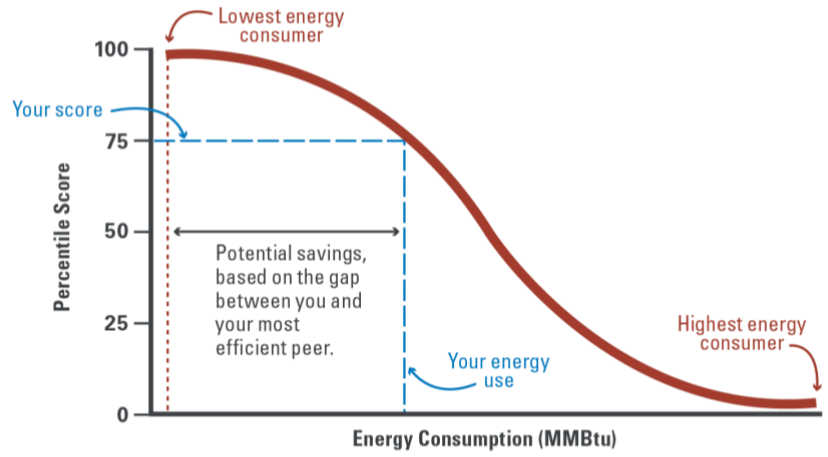
"Benchmarking externally is important. Energy managers can learn so much from comparing their performance to a similar group, both in how they perform and also in how they measure. EPIs are designed to compare plants of similar size and provide a form of third-party benchmarking. The EPI allowed us to add depth to our internal analyses and strengthen our energy performance." – Melanie Gourley, Sustainability Officer, Westland Distillery

Some industries look at the energy intensity of their plants by employing simple comparison methods. These industries collect data, calculate the energy intensity for each plant in the industry, and plot plant energy intensities on a bar chart. Energy intensity is a useful metric, but it is not an inherently comparative metric. Further, energy intensity does not provide insight into the effects that certain factors, such as weather, may have on a plant's energy performance.

ENERGY STAR EPIs, on the other hand, are statistical models that adjust, or normalize, for the differences among plants.[1] By normalizing for factors that affect energy consumption, EPIs enable plants to be compared on an even playing field. For example, large plants tend to have lower energy intensity than smaller plants due to economies of scale, and plants in warmer climates may use more energy than plants in cooler climates if they are climate conditioned. Some EPI inputs, or variables, have large impacts on the benchmark, while others have relatively minor effects. The magnitude of a variable's impact depends on its effect on energy consumption at the plant. The statistical analysis determines the relative impact of each variable.

[1] A small number of industries have access to an analysis of plant energy performance comparable to the EPI. For example, Solomon Associates produces a measure of energy intensity called the "Energy Intensity Index" for oil refineries.

Figure 1 demonstrates how the EPI provides insight into a plant's energy performance and the amount of energy improvement that is possible for that plant based on how similar plants in the industry are performing.



Y-Axis: Percentile Score
Shows the percentile of the highest (100) and lowest (1) performers. A plant's percentile is based on where its consumption intersects with the curve.

X-Axis: Energy Consumption
Displays the amount of energy a plant would use based on its sector and the conditions in which it operates. Where a plant falls on the curve represents the amount of energy the plant consumes.

Figure 1. Understanding the ENERGY STAR score.

How To Use an EPI

EPIs are statistical models embedded within a Microsoft Excel workbook.[2] Each tool contains worksheets for:

- Instructions (for using the tool),
- Data entry and interpreting results (EPI worksheet),
- Documenting a plant's Statement of Energy Performance, and,
- Supporting behind-the-scenes calculations performed by the tool.

EPIs are available for industry use and may be downloaded from www.energystar.gov/epis. Prior to using an EPI, users should read through the entire tool to become familiar with its operation.

Determine Whether a Plant Is Eligible To Be Scored

EPIs are designed for specific plant types and contain detailed instructions on the applicability to plants in an industry. EPIs require that at least 50% of total production must come from a specific list of defined products and that certain manufacturing processes be present at a plant. Products and manufacturing processes are defined in the Instructions worksheet. Read the full description of the EPI's applicability in the Instructions worksheet of your EPI to determine whether the EPI can accurately score your plant.

[2] The EPI model in an Excel workbook may be downloaded by users to their computer. Use of the EPI does not convey information outside of an organization unless the workbook is deliberately shared.

Gather the Necessary Data To Produce a Score

EPIs require 12 months of continuous data on energy consumption, production, and plant characteristics.[3] The data required by your industry's EPI was reviewed by experts from the industry and determined to be relevant for comparing the wide variety of plants across your industry.

Energy data includes the net values of all forms of energy *purchased or transferred into* the site during the reporting period.[4] This includes all purchased electricity, fossil energy, onsite renewables, and other alternative fuels. Energy created as a byproduct of the production process and consumed by the plant should not be included, since using the byproduct is considered an efficiency.

Production data requirements will vary by industry but generally include total quantity of products and subtotals for individual product types and may include a plant's maximum production capacity for a given year.

Plant characteristic data help the EPI create an even playing field when comparing different kinds of plants. These types of data make normalization possible and may include factors such as weather (climate) data, square footage of different production spaces, whether the plant has onsite wastewater treatment, or how many kilns or furnaces there are at the plant.

EPIs include the option for users to enter energy costs. Entering energy cost data allows users to evaluate the cost savings of potential energy improvements alongside the change in energy performance score, but the cost data do not affect the score. This is useful information when informing decisions about plant upgrades.

Enter Collected Data into the EPI

The EPI worksheet contains fields for energy, production, and plant characteristic data entry. Two columns are provided: one for a *current* plant and another for a *reference* plant. Each column calculates an ENERGY STAR score independently. The Current Plant column is intended for data associated with the plant's most recent data year. The Reference Plant column is provided for ease of comparison and can be used 1) to show the score for a previous year's performance data for the same plant, 2) to provide a score for another similar plant, or 3) as a hypothetical plant to examine how specific changes would affect energy efficiency.

When inputting data into the EPI worksheet, a common mistake users make is to enter incorrect units. Most EPIs offer the option to select either U.S. or International Units in the Plant Characteristics section. This option is unrelated to the energy units selected, as each energy source has a drop-down box included with the most common units for that energy type. If your company tracks energy in a unit not listed, convert your energy units to one of the provided units *before* entering them into the tool. Generally, energy data should be entered in higher heating value (HHV)[5] consistent with the individual EPI's Instructions worksheet.

[3] This can be a calendar year, fiscal year, or any 12-month period, but all data (energy, production, etc.) for the plant must be from the same period.

[4] For detailed rules on energy accounting for purposes of avoiding double counting, please see the Instructions of individual EPIs.

[5] Except for the few EPIs (e.g., the Cement EPI) where lower heating value (LHV) is specified in the Instructions.

Interpreting Your Results

Once data have been properly entered, the EPI will provide multiple informational outputs in the Results section, including the ENERGY STAR score. Figure 2 provides an example of the Results section and illustrates the additional useful and basic information the EPI can provide.

A Plant's Score

Based on the information input into the EPI, the statistical model will predict the total energy a plant is expected to use. The underlying statistical model is based on actual industry data and distributes scores among quartiles as evenly as possible. If there were an industry with 100 plants that differed only in their energy use, approximately 25 plants would fall into each quartile (0-24, 25-49, 50-74, 75-100). If the plant uses less energy than the predicted value, the score would be somewhere above 50, and if the plant uses more energy than the predicted value, the score would be somewhere below 50. The plant's score depends upon the magnitude of the difference between the actual plant energy performance and the predicted value; this is the plant's measure of efficiency.

The score is a facility-level, percentile-based metric that has been normalized for key industry-specific variables. The ENERGY STAR score answers the earlier question that helped define the EPI: "If all plants in the industry had the same characteristics and operating conditions as my plant, what percentage of plants in the country would use less energy and what percentage would use more energy?"

The ENERGY STAR score is a best-in-class efficiency measure for the specific combination of plant characteristics provided; the predicted energy benchmark shifts depending on these characteristics. The score accounts for other factors that affect energy consumption. For example, in many industries, there is an energy intensity advantage to producing higher quantities of product. Sometimes, larger plants may have lower energy *intensities* compared to their smaller peers. Although smaller plants may never match the same intensity efficiencies as larger plants due to economies of scale, others may be better optimized for energy performance given the limits of their specific operating and market conditions.

If a company has a portfolio of plants in a specific industry, that company may know which is their best plant but know nothing about how that plant stands within the context of the broader industry. The ENERGY STAR score provides information on the standing of a plant against peer plants across the industry—so one company's best plant may only be average when compared to the rest of the industry. Plants can also be compared to glean useful knowledge about each site beyond the simple KPI of energy intensity. For example, a plant could have a higher intensity due to the mix of production at that site but actually be more *efficient* than a plant with a different production mix and lower energy intensity. This indicates that although a site may be performing better than others on a simple intensity basis, more energy efficiency improvement projects could still be achievable at that site.

A Plant's Energy Intensity

The EPI uses source energy as the basis for benchmarking, but it reports results in both source and site energy:

- *Source energy* is based on energy consumed directly at the plant but accounts for energy conversion losses during generation, transmission, and delivery of energy to the plant.
- *Site energy* is based on energy consumed directly at the plant.

Energy intensity shows how much energy is needed to make a unit of product. The tool calculates the intensity by dividing total source energy by total production. Energy intensity can be used as a baseline against which a plant can compare improvements in energy management. See section A in Figure 2 below.

The Energy Intensity of an Average or an Efficient Plant

The EPI also shows how much energy a plant would use, holding all other plant characteristics constant, if its score was a 50 (average) or a 75 (efficient). These EPI benchmarks are shown in the last two columns of the results section of the EPI under "average plant" (50th percentile) and "efficient plant" (75th percentile). These are two of the benchmark values that the EPI generates based solely on the plant's characteristics. See section B in Figure 2 below.

How Much Money Can Be Saved by Becoming More Energy Efficient?

If energy cost data are entered, the EPI shows how much money an average plant (score of 50) and an efficient plant (score of 75) with the same characteristics would spend annually on energy.[6] Take the difference between the current plant energy spending and the spending of an efficient plant to see how much money you can save on utilities by operating the plant more efficiently.

How Much Money Is Being Saved by Operating the Plant Efficiently?

If your plant has a high score, calculate the difference between the amount your plant spends and the amount an average plant spends. This shows how much money you are already saving on utilities by operating more efficiently than average. See section C in Figure 2 below. Use this figure to justify continued investment in your energy program.

Results	Your Current Plant Enter Name 2024	Your Reference Plant Enter Name 2023	Average Plant Enter Name 2024	Efficient Plant Enter Name 2024
Display energy results in: US Units	C		B	B
Energy Performance Score (EPS)	41	48	50	75
Source Energy (MMBtu)	6,058,890	5,974,112	5,888,913	5,434,697
Site Energy (MMBtu)	4,884,818	4,830,040	4,747,778	4,381,579
Annual Energy Cost ($/year)	$90,775,000	$89,875,000	$88,228,379	$81,423,265
Total Production (Short Tons)*	1,425,833	1,450,000	1,425,833	1,425,833
Energy Cost/Total Production ($/Short Ton)*	$70.41	$69.13	$68.44	$63.16
Energy Intensity (Source MMBtu/Short Ton of Production)*	4.70 A	4.60	4.57	4.22

*Production units in the Results section match those selected in the above Plant Characteristics section.

Figure 2. Understanding information provided by the EPI about your plant.

[6] Spending is modeled based on the energy costs and plant characteristics entered in the EPI.

Setting Plant Energy Performance Goals

Setting realistic and challenging goals for plant energy performance is a best practice of energy management. EPIs can aid energy managers with this type of goal setting as the plant characteristics would remain unchanged, but the user can input different levels of energy use for the various types of energy. This allows the user to see how much of an energy reduction would be required to shift the ENERGY STAR score. For example, EPIs help address the question, "would the 10% goal established by the ENERGY STAR Challenge for Industry shift the plant into a new quartile or move it only a few percentiles?" When a 10% reduction in energy intensity leads to only a small increase in the ENERGY STAR score, that information suggests there is a large range of energy performance in that industry, and thus finding improvement opportunities to increase efficiency should be more likely. Conversely, when a 10% reduction in energy intensity would lead to a very large score change, that result suggests plant energy performance is tightly clustered in the industry and substantial improvement opportunities may be more difficult to find.

There are many energy performance evaluations that are not covered in this brief guide that energy managers can perform using an EPI. Assistance with understanding and interpreting the score and all the results provided by the EPI is offered by the ENERGY STAR Industrial Team. Contact ENERGY STAR for assistance at energystrategy@energystar.gov.

Unusual Operations and Sector-Specific Instructions

Some plants within an industry have unusual onsite operations that fall outside the scope of the EPI even though the plant as a whole meets the eligibility requirements. In such circumstances, plants that submeter operations that are clearly defined as outside the scope of the EPI can exclude this energy from the total plant energy. Before removing any energy from the plant total, it is essential that users review the Instructions worksheet to understand what should or should not be included in the EPI inputs.

Generally, the EPI encompasses the entire plant's operations—but sometimes co-located activities are not the norm for an industry, and the plant boundary needs to be defined to align with the EPI's underlying data. For example, in the cement industry, the plant

Closing the Energy Performance Gap

If a racer is trying to move from the middle of the pack to the lead, the distance that racer needs to cover depends on how closely the runners are clustered. The same applies to plant performance: How much of an energy reduction will be needed to move from an ENERGY STAR score of 50 to 75 depends on the industry.

A plant's ENERGY STAR score is determined based on where its actual energy consumption falls on the distribution curve generated by the EPI. Some industries have narrow distributions where the difference between an "average plant" (a score of 50) and an "efficient plant" (a score of 75) can be as little as ~5%, while other industries' differences can be much larger. Industries with narrow distributions mean most plants in the industry are performing quite similarly to one another. Industries with wide distributions have big differences in performance between the leaders and laggards.

To illustrate, an average plant that reduces energy use by 5% in the cement industry could score a 75, but a commercial bakery would have to lower energy by ~16% to achieve the score of 75. This is because the cement industry has a very narrow distribution as measured by the EPI while the commercial bakery industry has a wider one. The EPI tells each industry what performance is possible and how far a plant would need to go to catch up to the leaders.

boundary *expands to include* energy from the quarry for purposes of entering data into the Cement EPI. Conversely, in the case of automobile engine manufacturing, the plant boundary may be *reduced to exclude* energy from laboratory and research and development spaces when entering data into the Engine EPI. The ENERGY STAR team has encountered several examples of operations that are considered outside the scope of an EPI: These include a distillery that also functions as a brewery and an automobile assembly plant with its own plastic injection molding operation. Since plants are diverse, there are likely many more examples. However, not every unusual activity should be removed: Activities that you may consider separate from the core operations of a plant may actually be common practice in the industry and already accounted for when developing the EPI; therefore, it is critical to read the Instructions worksheet. If you have questions about whether an operation should be included, contact energystrategy@energystar.gov for assistance.

The U.S. EPA has noticed EPI users sometimes miss important assumptions and considerations in the use of specific EPIs. Although there are many similarities across the EPIs, it is important to pay close attention to the instructions for each, specifically regarding plant eligibility and data boundaries. A few examples of these considerations that affect the associated results and score follow.

- The Commercial Bread and Roll Bakery EPI may only be used for bakeries that process a minimum of 8 million pounds of raw dough per year.
- The Cement Manufacturing Plant EPI requires that all energy values be entered in LHV—*not* in HHV.
- When weather is an input variable for any EPI, the data should be secured from the ENERGY STAR Portfolio Manager® official source (https://portfoliomanager.energystar.gov/pm/degreeDaysCalculator) and not collected from the plant itself.

Each EPI has specific instructions and potential use limitations. Users should read the instructions carefully.

Leveraging the EPI

ENERGY STAR partners have used EPIs to inform goal setting, model impacts of investments, monitor energy performance on a regular basis, and enhance their existing energy management systems.

Goal Setting

Use your EPI results to set goals. Suppose that a poorly performing plant seeks to become an average performer or a better performer wants to score a 75 and earn ENERGY STAR certification. The EPI shows what it takes to achieve those goals. The EPI reports the total source energy (TSE) that both an "average plant" and an "efficient plant" are expected to consume based on the user-provided production and plant characteristics. Since the EPIs are developed using actual industry operating data—not theoretical engineering estimates—these levels are proven to be achievable. Comparing current energy use with those benchmarks shows what it takes to close the efficiency gap.

Impacts of Upgrades at a Plant

Use the EPI to see how plant upgrades will affect energy efficiency. Enter energy and plant characteristic data in the Current column. In the Reference column, enter estimates of the same types of data expected for an improved plant under the "upgrade" scenario to see how much the expected energy use and resulting score change. By entering the various types of energy into the EPI one at a time, you can observe which changes in energy—electricity or fuels—will have more or less impact on the ENERGY STAR score. The EPI will "score" a project on a percentile change basis.

"MGP [a distilled spirits producer] uses the EPI not only to get scores for our facilities' current levels of energy performance, but also to forecast the scores for future projects." — Munim Hussain, Corporate Director, Environmental Sustainability, MGP

Rolling 12-Month

Many users input their new annual data into the EPI once a year to see how energy performance at a plant has changed over the past year. However, the EPI can also be used more regularly to detect emerging concerns. The EPI requires 12 months of data to produce a score, but it need not be a single calendar or fiscal year: Any rolling 12-month time period works. With this in mind, users could update the EPI every month. In such a case, 11 months of data would be unchanged—you would simply remove the oldest month's data and add the most recent month's data. Any changes to the benchmark conditions, energy use, and the resulting score allow the user to evaluate the effects of a recent month's operations in comparison to the same month in the prior year.

Nissan North America uses its auto assembly EPI to evaluate plant performance on a rolling 12-month basis. Recently, several months passed where a plant's score remained the same; then it declined. Nissan looked at fluctuations in score on a monthly basis to identify the impacts on performance such as production changes. The drop in score provided impetus for evaluating why it was changing. Nissan considered it a "call to action" and focused attention on fixed energy use, adjusting compressed air usage and fixing other impacts to return the plant to an acceptable score.

Detailed Rolling 12-Month Example

Starting with data from the prior year in the EPI and entering new data one data element at a time, a user can determine how changes in operations cause the benchmark values of expected energy use to adjust and by how much. When the user then enters updated energy data, the model shows whether the change in energy use is more or less than the change in the benchmark. The benchmark adjusts based on altered plant characteristics combined with the modified energy results to produce a new score for the plant.

Consider the simple example of a plant with an energy-intensive product (A) and a non-energy-intensive product (B). In the most recent month, the plant experiences a 10% drop in A and a 20% drop in B. Lower production means lower energy use, so the 50th percentile benchmark will fall, but by how much? Entering these production changes one at a time provides the answer, but the change in annual production and benchmark energy use seems quite small. Recalling that 11 out of 12 months are identical, the small change in the benchmark applies to the most recent month compared to 12 months prior. Reducing production of A by 10% results in about 9% reduction in TSE; reducing B by 20% adds another 1.5% reduction in monthly energy consumption. Comparing the current month's energy intensity to 12 months prior shows that the plant's intensity can rise slightly and still maintain the same level of efficiency. This example looks only at two simple production changes that involved a slight change in capacity utilization and product mix, but more complex comparisons are possible. See Figure 3.

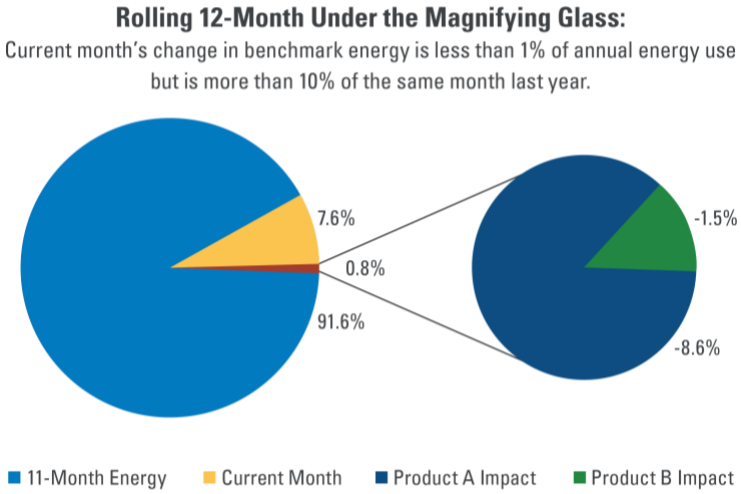


Figure 3. Understanding energy changes in a rolling 12-month example.

Integrating a Global Plant Portfolio

The rolling 12-month approach described above can be integrated with a company's production and energy data tracking systems. Many software systems can write and read directly in a spreadsheet, providing access to the EPI computations and automating the rolling 12-month approach. This can be implemented across a portfolio of plants, even globally. Plants located outside the United States are not eligible for ENERGY STAR certification, but the benchmarking information provided by an EPI is still useful for energy management.

This guide provides a snapshot of the types of calculations that are possible, but it doesn't provide a comprehensive list of all the advanced use cases that are possible with the EPI. Users are encouraged to think creatively about the questions they might answer using the tool. If assistance is needed, contact energystrategy@energystar.gov.

General Motors created benchmarking tools using its industry's EPIs to help assess and compare its global energy use and efficiency across the company's Assembly, Engine & Transmission operations.

"ENERGY STAR is a recognizable brand for energy efficiency. Plant certification allows us to recognize the site team who did all the work to achieve certification. Essentially, certification states: 'here is a team that worked hard to improve energy efficiency and reduce costs, and they achieved this third-party certification that is visible and public.' That achievement can be shared across the company and with consumers." — Andy Battjes, Director, Global Environmental Sustainability, Brown-Forman

Certifying a Plant with the ENERGY STAR

The U.S. EPA distinguishes the best-performing plants within an industry with ENERGY STAR certification. Certified plants are permitted to display the ENERGY STAR plant certification mark on their facility and associate their plant with the nationally well-known brand. Manufacturers certify their plants for a variety of reasons. A few include:

- **Validation of performance**: Certification provides confirmation from a third party, a trusted source— the U.S. EPA—that a plant is one of the most energy efficient in the country and validates the effectiveness of the plant's energy and sustainability team.

- **Competitive advantage**: Being certified sets a plant apart from competitors by demonstrating a commitment to energy efficiency and sustainability.
- **Employee pride**: Achieving certification can boost employee morale and pride in working for a company that demonstrates its performance and their accomplishments.
- **Community relations**: Certification recognizes a plant for environmental stewardship and can foster goodwill with the community.

To certify a plant, the following conditions must be met:

- A plant's ENERGY STAR score must be 75 or higher using the correct EPI for the plant type;
- The plant must meet U.S. EPA environmental compliance criteria;
- A licensed professional engineer must verify the EPI data and stamp the Statement of Energy Performance; and
- An application for certification must be submitted to the U.S. EPA.

ENERGY STAR certification for plants and instructions on how to apply are fully described at www.energystar.gov/plants.

In Summary

An ENERGY STAR EPI is a valuable tool that can inform energy managers and plant operators about the energy performance and operation of a manufacturing plant compared to its industry peers. The EPI is more than just a tool for checking annually whether a plant qualifies for ENERGY STAR certification. It is a management tool that provides insight into measuring the efficiency gap between average and top performers in a specific industry. The EPI informs meaningful goal setting and enables simple scenario analysis for evaluating potential plant upgrades and projects. Using the EPI on a rolling 12-month basis can provide additional insights into monthly changes: The EPI can be integrated with other KPIs to provide an early warning if performance is slipping or provide an assessment of projects' performance. Examining how changing plant operations might shift the benchmark provides awareness of external factors' impacts on energy use.

The EPI is your tool, so leverage it for maximum value in managing energy savings. Making the most of the tool by exploring its basic and advanced uses is an energy management best practice.