



ENERGY STAR Challenge for Industry

Participant Handbook

March 2016

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Overview

The U.S. Environmental Protection Agency's (EPA) ENERGY STAR Challenge for Industry is a tool designed to help energy managers and industrial sites improve site energy performance and set goals. Industrial sites participate by committing to the pre-established goal of reducing energy intensity by 10 percent within 5 years or less.

There are good reasons to participate. Industrial sites:

- ★ Create momentum for energy initiatives by setting an improvement goal;
- ★ Establish energy management practices for tracking and benchmarking energy performance to produce results;
- ★ Leverage ENERGY STAR, the most recognized name in energy efficiency, to motivate sites; and,
- ★ Demonstrate a commitment to protect the environment by pledging to improve energy performance.

**Industrial sites
commit to the goal
of reducing energy
intensity by 10
percent within 5
years or less.**

Any industrial site can take the ENERGY STAR Challenge for Industry. Companies are encouraged to promote this tool among their industrial sites worldwide.

Participation is easy. Sites follow these seven steps.

1. Establish an energy intensity metric;
2. Select an energy tracking method;
3. Set a baseline and 10 percent improvement goal;
4. Create a formal site file and plan for tracking data;
5. Register for the Challenge;
6. Track energy use and achieve the 10 percent reduction; and,
7. Verify energy savings and apply for recognition.

Recognition of good work motivates better performance. U.S. EPA recognition¹ includes:

- ★ An official certificate from the ENERGY STAR program documenting savings;
- ★ The opportunity to be profiled on the ENERGY STAR web site;
- ★ A congratulatory letter from U.S. EPA to the company's CEO highlighting the site's accomplishments; and,
- ★ Materials for communicating the site's achievement within the organization.

¹ To be recognized by U.S. EPA, a site's parent company must be an ENERGY STAR partner.

Participation Eligibility

An industrial site must meet the following requirements. A site's primary activity must be classified within one of the following North American Industrial Classification System (NAICS) codes.

- **Manufacturing (NAICS codes 31-33)** – The site must be engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products. The assembling of component parts of manufactured products is considered manufacturing, except in cases where the activity is appropriately classified as construction.
- **Mining, Quarrying, and Oil and Gas Extraction (NAICS codes 21)** – The site must be engaged in extracting naturally occurring mineral solids, such as coal and ores; liquid minerals, such as crude petroleum; and gases, such as natural gas.
- **Agriculture, Forestry, Fishing and Hunting (NAICS codes 11)** – The site must be engaged in growing crops, raising animals, harvesting timber, and harvesting fish and other animals from a farm, ranch, or their natural habitats.

A site with mixed uses (such as those which include research and development, administration, and manufacturing) may participate in the ENERGY STAR Challenge for Industry as long as the manufacturing and research and development energy use makes up 50 percent or more of the site's total energy use. Otherwise, the site is ineligible to participate. Research and development space, for the purposes of the Challenge for Industry, includes laboratories, vivariums, clean rooms, product testing labs, and other areas requiring ventilation rates much higher than typical office and administrative spaces.

Mixed-use sites are not required to sub-meter to distinguish between industrial and non-industrial spaces but should be able to provide an estimate of the energy loads or use for each space type.

A site may be located anywhere in the world. For sites outside of the U.S. or its territories, the parent company must be an ENERGY STAR partner and operate industrial sites within the U.S. or its territories.

How to Participate

To participate in the ENERGY STAR Challenge for Industry, sites follow these basic steps.

Locations of all forms and tools referenced in this handbook are identified in Appendix 1.

Step 1: Establish an energy intensity metric

An energy intensity metric must be used to track progress toward meeting the 10 percent reduction goal at each site. The energy intensity metric may be set in terms of energy per unit of production or energy per square footage of the site, depending upon the energy load of the site (i.e., how and where energy is used).

The metric must capture the energy use intensity of the whole site – not individual processes or energy sources – and must account for all forms of energy (e.g., solid fuels, electricity, gases, etc.). All energy must be expressed in British Thermal Units (BTUs), and converted from “site” energy to “source” energy.²

The site’s energy load determines the proper type of metric to use.

- If 60 percent or more of the site’s *energy load is directly linked to industrial processes*, then the metric must reflect a measure of production (e.g., BTU/pound of product). Sites are encouraged to use existing production-based energy intensity metrics as long as these meet the criteria.
- If 60 percent or more of the site’s *energy load is due to non-production process utility systems* (e.g., lighting, heating, and cooling), then the metric must reflect a measure of the building (i.e., BTU/square footage). Sites using a building metric are encouraged to use **ENERGY STAR’s Portfolio Manager**, which normalizes for building area and weather.
- For sites with *energy loads not meeting either of these criteria*, a metric may be developed that is representative of the site’s operations. When a non-production/square footage metric is used, a rationale must be provided in the **Challenge for Industry Registration Form** (Step 5).

² “Site” energy is the amount of energy (including electricity) consumed at an industrial site. “Source” energy represents the total amount of raw fuel that is required to operate an industrial site and incorporates all transmission, delivery, and production losses, thereby enabling a complete assessment of the energy efficiency of an industrial site. Energy may be delivered to a facility as primary and/or secondary energy. For more information on converting “site” to “source” energy, see Appendix 3 of this handbook, or see “Understanding Source and Site Energy” and use the Quick Converter tool on the ENERGY STAR Web site.

To learn more on how to develop an energy intensity metric for a site, please see Appendix 3.

Step 2: Select an energy tracking method

To track energy over time, a system must be in place to ensure consistency. Sites using a production-based energy intensity metric (e.g., BTU/pound of product) may use one of the following methods.

1. An existing energy tracking system;
2. The **ENERGY STAR Energy Tracking Tool**; or,
3. An **ENERGY STAR Plant Energy Performance Indicator**, if one is available for the specific site type.

Sites using a building-based energy intensity metric may use U.S. EPA's online **ENERGY STAR Portfolio Manager** tool to track energy use, or another existing system that normalizes for weather. Within Portfolio Manager, sites must choose the space type category of "Other."

Sites that normalize using a multivariate energy intensity metric and statistical models are permitted to use these metrics and their existing tracking method as long as they capture annual energy use. Such sites must provide a rationale when registering for the ENERGY STAR Challenge for Industry and must indicate that their baseline, metric, and reduction goal are based on this method when applying for recognition.

Step 3: Set a baseline and 10 percent improvement goal

Calculating a change in energy intensity requires establishing a starting point for measuring improvement, known as the baseline. The baseline must cover a full, consecutive twelve-month period (e.g., April 2014 through March 2015) prior to registering for the ENERGY STAR Challenge for Industry, and represent the site's corresponding energy intensity for that identified period.

The baseline may be defined in several ways using one of the following methods.

- The immediate past calendar year (e.g., a site signing up in April 2016 could set their baseline as January 1 – December 31, 2015), or
- Another consecutive 12-month period such as the most recent 12 months (e.g., a site signing up in April 2016 could set their baseline as April 1, 2015 – March 31, 2016), provided that the baseline end date is within 12 months of the date the baseline is registered with EPA, or,
- The company's most recent fiscal year.

Note: Sites are encouraged to consider a baseline period consistent with their company's energy data tracking cycle to make calculations convenient.

To determine a site's energy intensity for the baseline period, total the site's source energy use across the full twelve-month baseline period (Note that use of the ENERGY STAR Quick Converter, found on the Challenge for Industry tools and resources webpage, and in the Statement of Energy Improvement workbook, is strongly recommended). If using a production-based metric (e.g., BTU/pound of product), divide the total energy use by the total production of the same period. If using a building-based metric (e.g., BTU/square footage), divide the total energy use by the total of that building measurement. The result of either calculation is the average annual energy intensity for the baseline period.

After the baseline is set, determine the energy intensity reduction needed to achieve the 10 percent reduction goal. For example:

Baseline annual energy intensity = 500 BTU/pound of product
Improvement goal = 10%

In this example a 10% reduction from the baseline of 500 BTU/pound of product is 50 BTU/pound of product. The resulting energy intensity reduction goal that must be achieved would be 50 less than the baseline of 500, which is 450 BTU/pound of product.

Intensity reduction required to meet the goal: 500 BTU/pound of product x 10% = 50 BTU/pound of product
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Energy intensity reduction goal: 500 BTU/pound of product – 50 BTU/pound of product = 450 BTU/pound of product
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Please note that the Statement of Energy Improvement – the official form used for showing your achievement of the Challenge for Industry – requires that source MMBtu for Electricity and Thermal Energy be reported separately, so consider tracking both electricity and thermal components starting from the calculation of your baseline period.

Step 4: Create a formal site file and plan for tracking data

Sites participating in the ENERGY STAR Challenge for Industry are required to establish a formal site file that includes all data used to participate in the ENERGY STAR Challenge for Industry, and documents all data sources and assumptions. This file must be kept at, or be accessible from, the site. In the case of sites located outside the continental U.S., a copy of the file must be kept with the corporate energy manager.

The file may be physical or electronic, but must serve as a static, central repository of all relevant information (e.g., emails discussing assumptions, baselines, etc. are copied to the official file instead of residing in individual email boxes; data from a company database are copied to the official file in a spreadsheet, screen shot, etc.). The documentation included in this file must be sufficient whereby any person can understand the source of the data used. Appendix 2 discusses information that must be

included in the formal site file. The formal site file is not submitted to U.S. EPA, but must be used by the Professional Engineer (PE) for verifying the site's energy intensity reduction in Step 7.

Tracking energy use over time requires some simple planning to assure accuracy. Sites may use the **ENERGY STAR Challenge for Industry Energy Tracking Plan Template** to create a basic plan to ensure proper data management and documentation if existing procedures or processes are not in place. The Energy Tracking Plan will help you record important details about the information that will be tracked through the ENERGY STAR Challenge for Industry. This is especially important for assuring that the method of tracking each fuel type is consistent across the baseline and tracking periods, including energy sources that are invoiced at irregular (non-monthly) intervals. The Energy Tracking Plan is an internal tool for the benefit of the site and does not need to be submitted to U.S. EPA. Sites also may use existing data management procedures but must confirm a procedure is in place upon registration.

Step 5: Register for the Challenge

Register online by completing the **ENERGY STAR Challenge for Industry Registration Form**.

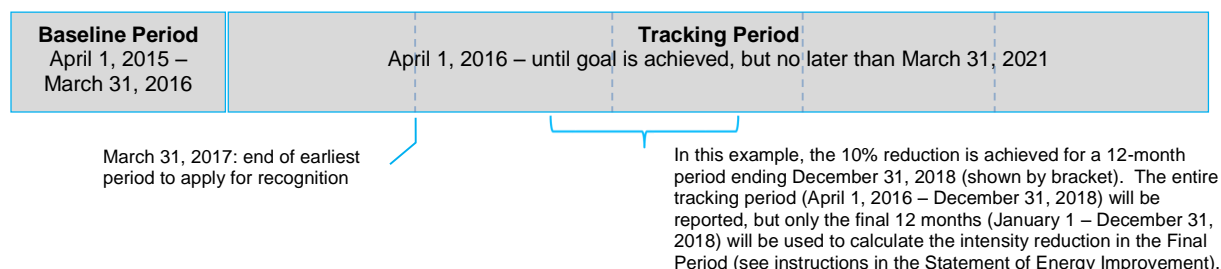
Step 6: Track energy use and achieve the 10 percent reduction

Tracking improvements in energy use begins immediately following the end of the baseline period. As participating sites build or refine an energy program, complete projects, and execute strategies to improve the site's energy intensity, the impacts of all actions are measured through the tracking system. ENERGY STAR resources can help a site improve! Find links in Appendix 1.

The target energy intensity may be reached no earlier than 12 months from the conclusion of the baseline period.


Annual reporting of progress is not required. A site submits a one-time report (the Statement of Energy Improvement) upon achieving the 10 percent energy intensity reduction and only if recognition is desired. This report will cover the entire tracking period, from the end of the baseline period through the end of the period for which the 10 percent reduction is achieved. The 10 percent energy intensity reduction is calculated for the final 12 months of the tracking period against the baseline period. If a site does not reach its goal within five years, there is no penalty to the site, and the site may re-register, if desired.

Example Timeline for Baseline, Tracking, and Recognition



Example Statement of Energy Improvement (Matching Above Timeline)

OMB Control No. 2060-0347



STATEMENT OF ENERGY IMPROVEMENT

Site Name Sample Plant

For Baseline Period
beginning the 1st of: April 2015

Site Address

Contact Name A. Sampleson

Street Address 123 Sample Way

Address 2 _____

City, State Sampleton, XX

ZIP 12345

Company/Owner Address (if different)

Name A. N. Owner

Street Address 100 Sample Boulevard

Address 2 _____

City, State Sampleton, XX

ZIP 12345

Energy Improvement

	Baseline March 2016	1 st Year March 2017	2 nd Year March 2018	3 rd Year March 2019	4 th Year March 2020	Final December 2018
Site Electricity (MMBtu)	2,866	2,771	2,707			2,675
Site Thermal Energy (MMBtu)	3,000	2,700	2,500			2,400
Source Electricity (MMBtu)	9,000	8,700	8,500			8,400
Source Thermal Energy (MMBtu)	3,000	2,700	2,500			2,400
Total Source Energy (MMBtu)	12,000	11,400	11,000	0	0	10,800
Widgets (Quantity)	1,000	1,005	1,010			1,010
Energy Intensity (MMBtu/Widgets (Quantity))	12.00	11.34	10.89	--	--	10.69
% Energy Intensity Reduction from Baseline		-5.5%	-9.2%	--	--	-10.9%
Annual Source Energy Avoided (MMBtu)		660	1,120	--	--	1,320
Annual CO ₂ e Avoided (metric tons)						

►
Instructions
Statement of Energy Improvement
Quick Converter ... (+) :

Step 7: Verify energy savings and apply for recognition

Achieving a 10 percent energy intensity reduction is an important step forward in managing energy. To be recognized by U.S. EPA's ENERGY STAR program, a site's

parent company must be an ENERGY STAR partner. Additionally, before recognition is provided, U.S. EPA requires the site to verify that the savings were achieved.

Sites applying for recognition must complete a **Statement of Energy Improvement**. The Statement of Energy Improvement provides the official documentation that the site has achieved the 10 percent energy intensity reduction. The Statement of Energy Improvement is provided in a Microsoft Excel® spreadsheet format and can be downloaded from the ENERGY STAR web site. Applicants fill in the required information on the Statement of Energy Improvement and have it validated by a PE. The PE completing the verification process must indicate on the Statement of Energy Improvement if the PE stamp is embossed.

PE validation also ensures the accuracy and completeness of:

- Site physical characteristics
- Site operating information
- Energy and related data
- Energy intensity reduction
- Avoided greenhouse gas emissions, if reported
- Formal site file

The PE must follow all instructions in the ***ENERGY STAR Challenge for Industry Professional Engineers' Guide for Validating Statements of Energy Improvement***.

When the Statement of Energy Improvement has been validated, the site must complete the online **ENERGY STAR Challenge for Industry Recognition Application Form** and send copies of the validated Statement of Energy Improvement and PE Verification Checklist to U.S. EPA via email to industrychallenge@energystar.gov.

Contact Information

For questions regarding the U.S. EPA's ENERGY STAR Challenge for Industry, refer to the following links:

- **E-mail:** industrychallenge@energystar.gov
- **Website:** <http://www.energystar.gov/industrychallenge>

U.S. EPA Review of ENERGY STAR Challenge for Industry Recognition Application

Upon receipt of an application for recognition, U.S. EPA will review the Recognition Application Form, the validated Statement of Energy Improvement, and the PE Verification Checklist to determine if the site is eligible for ENERGY STAR Challenge for Industry recognition.

U.S. EPA follows this procedure.

1. Review the application for completeness. Contact the applicant if any information is missing.
2. Confirm the site's parent company is an ENERGY STAR partner.
3. Verify that the baseline year and baseline intensity match those identified during registration. (Note: If the baseline or baseline intensity on the Statement of Energy Improvement do not match the baseline or baseline intensity provided to EPA during registration, an explanation for the difference must be noted in the PE Verification Checklist, accompanied by any necessary supporting documentation.)
4. Verify that the 10 percent reduction goal was met within 5 years or less by reviewing the data contained in the Statement of Energy Improvement.
5. Verify that the tracking period data in the Statement of Energy Improvement began immediately following the end date of the baseline period.
6. Verify that the final 12-months of the tracking period during which the 10 percent energy intensity reduction has been achieved ends at least 12 months after the conclusion of the baseline period.
7. Verify that the application was submitted no later than four months from the end of the final 12 months of the tracking period during which the site achieved the 10 percent energy intensity reduction.

EPA also reserves the right to request and review any records used to calculate energy performance. Therefore, the formal site file must be maintained for five years from the end date of the tracking period in which the 10 percent energy intensity reduction was achieved.

Continuing the Commitment

U.S. EPA is interested in the continual improvement of industrial site energy efficiency. U.S. EPA will recognize a site through the ENERGY STAR Challenge for Industry each time it reaches a 10 percent energy intensity reduction. For a site to continue its participation in the ENERGY STAR Challenge for Industry, it must re-register by setting a new baseline. For a site immediately re-registering upon achievement of the 10 percent energy intensity reduction, the baseline must be set as the most recent 12 months of the tracking period during which the ENERGY STAR Challenge for Industry was achieved. Sites not re-registering immediately must follow the instructions as if the

site were a new participant in the ENERGY STAR Challenge for Industry. In no case, however, may a site that has previously achieved the Challenge for Industry set a new baseline that precedes the latest achievement period.

Appendix 1. ENERGY STAR Tools and Resources Referenced in this Handbook

These tools are available at www.energystar.gov/industrychallenge.

ENERGY STAR Challenge for Industry Recognition Application Form

ENERGY STAR Challenge for Industry Registration Form

ENERGY STAR Challenge for Industry Statement of Energy Improvement

ENERGY STAR Challenge for Industry Energy Tracking Plan Template

ENERGY STAR Energy Tracking Tool

ENERGY STAR Plant Energy Performance Indicators

ENERGY STAR Portfolio Manager

ENERGY STAR Challenge for Industry *Professional Engineers' Guide for Validating Statements of Energy Improvement*

ENERGY STAR Quick Converter

Other ENERGY STAR tools and resources that can help you improve energy performance are available at www.energystar.gov/industry.

Appendix 2. Formal Site File

The formal site file is defined as the centralized repository of ALL materials related to a site that has achieved the ENERGY STAR Challenge for Industry. The file may be physical (e.g., a three-ring binder), electronic (e.g., a specific “folder” or directory saved on a corporate file server), or some combination. It is important that all information is compiled in a centrally accessible location so that the site contact or corporate energy manager has immediate access to the formal site file upon the PE verification process. For example, emails exchanged within the company or with U.S. EPA during the application process would be archived to the formal site file, not maintained in the corporate energy manager’s email box. Centralizing all information helps assure that the formal site file would not be lost when personnel change jobs.

The formal site file is a stand-alone, self-explanatory file. All source material, assumptions, communications, etc., are documented such that anyone reviewing the file would not need the site contact or corporate energy manager to explain why or how any aspect was executed.

The formal site file contains all information submitted to U.S. EPA as part of the ENERGY STAR Challenge for Industry recognition application. This includes the original PE-validated Statement of Energy Improvement, and copies of any communications exchanged with U.S. EPA regarding questions and clarifications to ENERGY STAR Challenge for Industry (e.g., emails discussing assumptions, baselines, etc. are copied to the official file instead of residing in individual email boxes; data from a company database are copied to the official file in a spreadsheet, screen shot, etc.). It will also include the original PE Verification Checklist completed at the conclusion of PE verification.

The formal site file contains all non-data background information supporting the site’s eligibility to participate in the ENERGY STAR Challenge for Industry and receive recognition. This includes:

- All documentation supporting that the site meets the definition of an industrial site.
- All documentation supporting the accuracy of the site’s physical characteristics and any other site-specific information required on the Statement of Energy Improvement (e.g., site name, location, parent company information, and contact names) matches that of the site applying for the ENERGY STAR Challenge for Industry recognition.
- All documentation showing U.S. EPA’s approval of the registered energy intensity metric and baseline.

- Documentation showing an Energy Tracking Plan or existing data management procedures were in place during the duration of the site's participation in the ENERGY STAR Challenge for Industry.

The formal site file contains all data underlying the numbers required on the Statement of Energy Improvement. This means:

- All documentation supporting the non-energy operating characteristics used to calculate the site's energy intensity metric and all documentation that this metric captures the production or square footage for the whole site.
- All documentation supporting the energy consumption used to calculate the site's energy intensity metric and all documentation that this metric captures energy for the whole site.
- All documentation proving that the data used to track the energy performance is from the site named on the Statement of Energy Improvement.
- For production-based energy metrics, all documentation supporting the production units used for calculating the energy intensity metric are consistent with numbers from official company production records.
- For building-based energy metrics, all documentation supporting the gross square footage of the site used for calculating the energy intensity metric are consistent with company records.
- For complex energy metrics, all documentation supporting that the approach was applied consistently during the tracking period and that the data used matches the source of the original normalized/multivariate data used to develop the metrics.
- All documentation supporting that the production, gross square footage, and/or normalized data used to calculate the energy intensity matches the data found in the site's energy tracking system, and that all data was tracked consistently throughout the duration of participating in the ENERGY STAR Challenge for Industry.
- All documentation supporting any other data used for normalization, if normalization was performed.
- All documentation supporting that all data used reflects the whole facility and not a single process or individual part of the site.
- All documentation supporting that all energy consumption for each energy source used to operate the facility and manufacturing processes (including purchased and generated) was accounted for and reported in the Statement of Energy Improvement.
- If a site exports electricity or steam, all documentation showing that these exports have been subtracted from the site's total energy use.

- Documentation/calculations showing that all forms of energy purchased and used on site were properly converted to BTUs.
- Documentation/calculations showing that all energy was properly converted from “site” to “source” energy, summed to Electricity and Thermal Energy categories, and reported on the Statement of Energy Improvement.
- Documentation supporting that the baseline data entered into the Statement of Energy Improvement matches the baseline approved by U.S. EPA when the site registered to participate in the ENERGY STAR Challenge for Industry. If the baseline or baseline intensity on the Statement of Energy Improvement do not match the baseline or baseline intensity provided to EPA during registration, an explanation for the difference must be noted in the PE Verification Checklist, accompanied by any necessary supporting documentation.
- All documentation supporting that the site reduced its energy intensity by at least 10 percent within 5 years of the conclusion of the baseline period and all data was accurately recorded.
- All documentation that the tracking period began immediately following the end date of the baseline period.
- All documentation that the 12 months of the tracking period during which the energy intensity reduction was achieved ends at least 12 months after the conclusion of the baseline period.
- For sites choosing to report the avoided carbon dioxide equivalent (CO₂e) emissions that are linked with the energy intensity reduction, all documentation supporting that the estimates were calculated correctly using proper emission factors.

Appendix 3. Selecting an Energy Intensity Metric

Energy intensity metrics can range from a simple ratio such as energy divided by production to complex multi-variant-based metrics calculated by algorithms. For the ENERGY STAR Challenge for Industry, sites are allowed to choose their own metric and may be able to use an existing metric. Sites can use either a simple energy intensity metric or a complex one, depending on their needs.

To participate in the ENERGY STAR Challenge for Industry, the energy intensity metric used to track performance must:

- Account for all fuel types (electric, thermal, etc.) used at the site in *source* British Thermal Units (Btus);
- Reflect how energy is utilized in the plant through either a *production-* or *building-*based measurement in the metric's denominator; and
- Help the site effectively manage energy use.

Energy Intensity Metric

Numerator (energy) /
Denominator (production
or building area)

While sites are given flexibility to select their own metric, using a denominator based on revenue, sales, or other monetary values that does not directly correspond with energy use is discouraged, and may be approved only in rare circumstances.

Sites are permitted to use a metric calculated from methods that normalize or control for specific variables, such as weather, production volumes, or product mix. Sites using a *multi-variant energy intensity metric* will need to provide a short description of the method used to calculate the metric when registering for the ENERGY STAR Challenge for Industry. Additionally, sites using a multi-variant energy intensity metric must convert all energy units to *source* energy.

The following sections provide more guidance on selecting an energy intensity metric.

1. Account for All Energy Sources

Sites participating in the ENERGY STAR Challenge for Industry pledge to reduce their total energy intensity by 10% or more within 5 years or less. To capture total energy intensity, sites must:

A. Identify all energy sources:

Identify each source of energy (e.g., electricity, fuels, steam) used at the site for production and operating the plant. Determine the annual energy usage for each source based on billing records. (For more guidance on energy use accounting, see section 3 at the end of this appendix).

B. Convert to British Thermal Units (Btus)

To calculate total energy, it is necessary to convert all energy to a common unit. British Thermal Units (Btus) are frequently used in energy management and by the ENERGY STAR program as the common unit for combining energy values. All energy sources used can be converted to Btus by using an appropriate conversion factor.

The **ENERGY STAR Quick Converter** tool provides a list of the conversion factors for common energy sources and can help you easily convert all your energy values to Btus.

C. Convert to *source* energy

Once all energy sources have been converted to Btus, you will have a profile of the plant's *site* energy by type. *Site* energy reflects the energy used only at your plant, but does not reflect the energy required to produce and deliver certain energy types, most commonly electricity, to your plant. *Source* energy accounts for the energy required to produce and deliver energy to your site. Converting to *source* energy provides an adjustment that accounts for off-site production and delivery losses for specific energy sources.

Converting to *source* energy is an important step for capturing efficiencies gained by on-site generation. For example, if solar panels are installed at a plant that has taken the ENERGY STAR Challenge for Industry, the plant should realize an efficiency gain by producing electricity on-site. If electricity usage is only measured in *site* energy, the efficiency gained by on-site generation cannot be counted since no adjustment factor is applied (i.e., 1 kWh of electricity at the site has a heat value of 3,412 Btu regardless of how that kWh was generated). However, if electricity usage is measured in *source* energy, this efficiency gain would be realized since the conversion factor for self-generated electricity accounts for this efficiency benefit (i.e., on-site generation from solar panels need not incur losses for generation, transmission, and distribution).

Converting *site* energy to *source* energy will make some of your plant's energy numbers appear larger. However, this conversion does not affect your plant's ability to achieve the Challenge for Industry reduction goal.

The conversion factors used to convert *site* energy to *source* energy can be found at the end of this appendix and in the **ENERGY STAR Quick Converter** tool. It is recommended that you use the Quick Converter tool to easily convert all your energy sources to *source Btus*.

D. Calculate total annual energy use in *source Btus*

Once all energy types have been converted to *source Btus*, calculate your total annual energy use by summing up the *source Btus*. This number represents your plant's total energy use for an annual period. You will use this number in the numerator of your plant's energy intensity metric when calculating your plant's baseline. Please note that the Statement of Energy Improvement – the official form used for showing your

achievement of the Challenge for Industry – requires that source MMBtu for Electricity and Thermal Energy be reported separately, so it would be a good idea to begin tracking both electricity and thermal components starting from the calculation of your baseline energy intensity metric.

2. Selecting a Production- or Building-Based Denominator

It is important to select an energy intensity metric that will help you effectively manage energy performance. Using a metric that reflects how energy is primarily used at your plant is the first step.

A. Production- or building-based metric?

If most of the energy used is in production and manufacturing processes, the denominator of your plant's energy intensity metric should be a measure of production, such as pound of product. However, if most of your energy loads are in building utility systems, such as HVAC and lighting, the metric should capture building system energy use, which is commonly represented by square feet of building area.

For the ENERGY STAR Challenge for Industry, EPA recommends selecting a production-based metric if roughly 60% of your energy loads are in manufacturing processes.

If you are not sure which loads are greater, begin by conducting an inventory of your largest energy-using processes or equipment. Use the energy use numbers from equipment nameplates, operating documents, or meters to develop an estimate of energy demand and use. Compare these numbers to the plant's total demand and usage to estimate which systems are the biggest energy users. Remember, you will need to convert all energy to a common unit (Btus) in order to compare electric and thermal energy usage. Once you have completed this inventory, you will have a load profile for your plant that can help with identifying areas to target for improvement.

It is not necessary to sub-meter each process to determine if demand or use is tied to production. Estimates made from available equipment information and load profiles should be sufficient to reasonably estimate the proportion of manufacturing energy use.

B. Mixed-use facilities

It is common in most manufacturing environments to have non-production areas that include offices, break rooms, cafeterias, storage, shipping & receiving, laboratory, and even research & development spaces. Because these space types are usually part of the whole facility or site, it is not necessary to sub-meter and subtract the energy use of non-production areas. The ENERGY STAR Challenge for Industry focuses on whole-plant energy performance and rewards plant-wide achievements. Therefore, the energy performance of all the space areas should be measured.

At sites where large non-production areas are co-located with manufacturing areas, it may be necessary to determine if the site qualifies as an industrial plant for the purposes of the ENERGY STAR Challenge for Industry. For example, a site containing a large office building complex and a small manufacturing plant will need to determine if more energy is used in the office area or in the manufacturing area. To participate in the ENERGY STAR Challenge for Industry, at least 50 percent of plant's total energy use must be tied to manufacturing and research & development.

Research & development space, for the purposes of the ENERGY STAR Challenge for Industry, includes laboratories, vivariums, clean rooms, product testing labs, and other areas requiring ventilation rates much higher than typical office and administrative spaces. Mixed-use sites are not required to sub-meter to distinguish between manufacturing and non-production spaces. Sites may provide an estimate of the energy loads or use for each space type for the purposes of determining the proportion of manufacturing and non-production energy loads.

C. Selecting a production-based metric

For sites where 60 percent or more of energy loads are tied to manufacturing processes, the denominator of the energy intensity metric should measure an aspect of production. If your company already has a production measure in place, use that unit. However, if your site or company does not have a production measure that will work well for energy management, then you will need to select one.

If your site produces only one product, identifying a production-based measure may be very easy. However, if your site produces multiple products or operates as a job shop, you may need to experiment with different measures until you find the unit that best corresponds with energy use across multiple products.

The production measure you select will need to be based on available data. Look at what units, numbers, and values are already tracked and used to monitor production. Commonly used production measures include, but are not limited to:

- Quantities (unit counts; shipped product; etc.)
- Physical measurements (weight, volume, area, length, etc.); or
- Temporal measures (operating hours, run times, labor hours, etc.).

Production measures may be used for both product outputs, such as *total finished products*, and/or production inputs, such as *gallons of milk* that are processed into multiple products.

If your site produces both finished products and parts, you may need to develop a method for calculating *equivalent* units. Equivalent units represent the number of units or parts that combined use the same amount of production energy required to produce

a single finished product. Accounting for equivalent units allows you to convert parts into the same unit used to measure finished products.

For sites producing multiple products, it will be necessary to identify a single production measure that can be used to measure whole plant performance. Because the ENERGY STAR Challenge for Industry tracks whole plant performance, it is necessary to establish a whole-plant energy intensity metric and baseline. This means that plants with multiple products will need to find a single metric that represent the site's total energy intensity.

Care should be taken in choosing a production measure to capture multiple products, since some measures may capture differences in product-level energy intensity better than others. Sites producing multiple products should examine the following:

- Differences in the energy required to produce each product.
- Contribution of each product towards total energy use.
- Correlations between energy use and product quantities.
- Correlations between energy use and physical characteristics.

Sites producing multiple products should also evaluate using a *production input* to measure total plant production. In situations where multiple products are made from a primary production input, it may be possible to use a measure of that input to capture total production. For example, a dairy producing multiple products, such as pasteurized milk, ice cream, and butter, should consider tracking production based on raw milk, the main material input that is common to all products.

For sites where there is a wide diversity of products, volumes, and product energy intensity, it may be better to use a multi-variant energy intensity metric that adjusts or normalizes for product mix.

D. Using a building-based metric

At sites where production energy use is less than 60 percent of total energy use, the denominator for the energy intensity metric should be based on the physical size of the structure where energy is used. A common building metric used in energy management is square feet. Sites should use only the square footage of physical structures that are heated, cooled, and illuminated. You should not include the total square footage of the site (e.g., outside spaces, parking lots, etc.)

At sites where heating and cooling are the major energy loads, weather can have a significant impact on energy use. Because energy managers cannot control the weather, sites should use a *weather normalized energy intensity* metric that normalizes for fluctuation in heating and cooling degree days between years. EPA's **ENERGY STAR Portfolio Manager** tool can be used to calculate a weather normalized energy use intensity in *source* energy per square foot (kBtus/sq. ft.). Additionally, Portfolio Manager can be used to calculate a baseline and track energy use over time. For sites

that will use a building-based energy intensity metric, EPA recommends using Portfolio Manager. More information on Portfolio Manager can be found at www.energystar.gov/portfolio manager.

E. Using a multi-variant energy intensity metric

Multi-variant energy intensity metrics are permitted for calculating a baseline and tracking energy performance for the ENERGY STAR Challenge for Industry. Multi-variant energy intensity metrics use additional variables beyond energy and production to calculate intensity. They can be calculated in a variety of ways and are often used to control or normalize for differences in weather, product mix, production volume, and other significant variables that affect energy use.

Because the units used to express a multi-variant energy intensity metric may not describe all the factors used to calculate the metric, sites must indicate they are using such a metric when registering for the ENERGY STAR Challenge for Industry and provide a brief description of the metric. Additionally, sites using multi-variant energy intensity metric must convert all energy units to *source* energy.

3. Additional Guidance for Energy Accounting

Grid Electricity – When electricity is purchased from the grid, track the total amount of as-billed electricity consumption. This will typically be found on monthly electric bills.

Natural Gas – When natural gas is purchased from a supplier, track the total amount of as-billed natural gas consumption. This will typically be found on monthly gas bills.

Fuel Oil and Propane – If fuel oil or propane is combusted, then the amount of fuel purchased and combusted must be tracked. Unlike electricity and natural gas, these fuels may not be delivered or measured within a monthly period. Internal company records are considered acceptable records for documenting fuel use.

Coal – If coal is purchased and consumed on site, the quantities or BTU value of fuel used must be tracked. Like fuel oil, these fuels will likely not be delivered or measured on a month-to-month billing period. Internal company records are considered acceptable records for documenting fuel use.

District Energy (hot water, chilled water, steam) – If district energy is purchased from the utility, the monthly quantity of consumption must be tracked. You must track the total amount of as-billed district energy consumption, typically found on monthly bills. All purchases of district energy must be accounted for in the site's total energy consumption, and converted to source energy using the ratios in Appendix 4 or another documented source.

On-Site Solar and Wind Electricity – Sites are required to track the amount of electricity that is generated from on-site solar or wind energy sources and used on site. Sites

should account for, and not include as consumption, any energy sold to the grid. All energy generated and used on-site from these sources must be accounted for in full.

On-Site Combined Heat and Power (CHP) – CHP systems consume a single input fuel (e.g., natural gas) to produce both heat and electricity. In these situations, the input fuel must be tracked. All input fuels must be included in the total energy consumed. This may be found on monthly bills for a fuel such as natural gas, or from other irregular billing periods for diesel oil or coal. You must not include the amount of heat and electricity generated from the CHP system in their total energy calculations.

Fuels for combustion motors – If fuel, such as diesel, propane, and gasoline, is used to power machinery, generators, vehicles, and other equipment with combustion motors that are required for operating the site or are part of the site's production process, the total fuel use must be tracked and accounted. Internal company records are considered acceptable records for documenting fuel use for these sources.

Wood and Biomass – If wood or biomass fuels are purchased and consumed on site, the quantities or energy value of these fuels must be tracked and accounted for. Like fuel oil, these fuels will likely not be delivered or measured on a month-to-month billing period. Internal company records are considered acceptable records for documenting fuel use.

Waste fuels – If waste fuels, such as municipal solid waste, animal by-products, tire-derived fuels (TDF), and other by-products of production are combusted as fuel, either quantity or fuel value of these fuels must be tracked and accounted for. Like fuel oil or biomass, these fuels will likely not be delivered or measured on a month-to-month billing period. Internal company records are considered acceptable records for documenting fuel use.

Process gases – If gases created by industrial processes are combusted as fuel, the volume or fuel value of those gases should be tracked and accounted for as part of the site's total energy consumption. Internal company records based on either metered fuel use or engineering estimates that document the quantity of process gases consumed must be reviewed to ensure proper tracking.

For all energy sources, be sure the method of tracking each fuel type is consistent throughout the baseline and tracking periods. For example, if an electricity bill is always issued for a period beginning on the 10th of a month, and ending on the 9th of the next month, the plant must be consistent in how that bill is tracked (e.g., always considered to be the bill for the previous calendar month; prorated to cover the correct number of days of each calendar month; etc.). Adopting consistent tracking methods is especially important for fuels that are not delivered or measured on a month-to-month billing period.

Note that Grid Electricity, On-Site Solar and Wind Electricity, and Purchased Compressed Air will be categorized as Electricity, and all other energy sources will be categorized as Thermal Energy.

4. Source-Site Ratios used by ENERGY STAR

The following ratios are used to convert site energy in Btus to source energy in Btus. To convert from site to source energy, first convert all energy units to Btus. Then multiply the site energy Btu value by the source-site ratio to convert to source Btus.

Source-Site Ratios used by ENERGY STAR	
Fuel Type	Source-Site Ratio
Electricity (Grid Purchase)	3.14
Electricity (On-site Solar or Wind Installation)	1.0
Natural Gas	1.05
Fuel Oil (1,2,4,5,6, Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam (Purchased)	1.20
Hot Water	1.20
Chilled Water	1.0
Wood / Biomass	1.0
Coal / Coke	1.0
Process Gases	1.0
Other fuels burned on site	1.0

For more information, see “Understanding Source and Site Energy” and use the Quick Converter tool, both on the ENERGY STAR Web site. Quick Converter is found on the Challenge for Industry tools and resources webpage, and in the Statement of Energy Improvement workbook.