ENERGY STAR® Challenge for Industry

Professional Engineers' Guide for Validating Statements of Energy Improvement

United States Environmental Protection Agency

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Introduction

The U.S. Environmental Protection Agency's (U.S. EPA) ENERGY STAR program provides guidance, tools, and recognition to help companies improve their energy performance. ENERGY STAR is a voluntary partnership program that companies choose to join. Through ENERGY STAR, U.S. EPA offers a number of forms of recognition for achievements in energy efficiency.

The **ENERGY STAR Challenge for Industry** recognizes individual industrial sites for achieving a 10 percent reduction in energy intensity within 5 years from the conclusion of an established baseline. To be recognized by U.S. EPA for this accomplishment, sites must register for the ENERGY STAR Challenge for Industry and the site's parent company must be an ENERGY STAR partner. A site can apply to U.S. EPA for recognition for achieving a 10 percent reduction in energy intensity if the period during which the reduction is achieved ends no earlier than 12 months from the conclusion of the baseline period and not later than within the 5-year period that follows the baseline period (i.e., not fewer than 12 months, nor more than 60 months, following the baseline period).

The application for recognition requires the site to have a Professional Engineer (PE) verify the site's energy intensity reduction by reviewing energy and related data. It is the responsibility of the site applying for recognition to complete and submit the application for recognition.

A PE provides unbiased engineering services and is legally bound to uphold standards of ethics. Because of this high level of professionalism, U.S. EPA requires that a PE must validate each Statement of Energy Improvement that is used to apply for site recognition. Further, the PE must be licensed within one of the U.S. states, a Canadian Province, or territory of the U.S. or Canada.

The PE conducting the verification process is permitted to be employed by the organization or site participating in the ENERGY STAR Challenge for Industry.

The PE's primary role is to validate that all data provided to U.S. EPA on the Statement of Energy Improvement are accurate and the site has followed the basic requirements of the ENERGY STAR Challenge for Industry. The PE should first review *How to Participate*, which is provided in Appendix 3.

The PE must verify that the site data are accurate. This includes verifying physical characteristics, operating characteristics, and energy consumption. Validating a Statement of Energy Improvement requires the PE to review categories of user-provided information.

The PE is not obligated to conduct additional analysis, but should be able to use his/her professional judgment to assess whether all site data and information is tracked and recorded accurately.

This document, the *ENERGY STAR Challenge for Industry Professional Engineers' Guide for Validating Statements of Energy Improvement,* is intended to assist a PE in understanding the requirements of the ENERGY STAR Challenge for Industry and validating the Statement of Energy Improvement.

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Review and Verification Process Overview

The process for validating a Statement of Energy Improvement requires completion of these seven steps:

1. Verify the site's physical characteristics.
2. Verify site operating information is accurate.
3. Verify energy and related data are accurate.
4. Verify the energy intensity reduction.
5. Verify avoided greenhouse gas emissions, if reported.
6. Validate the Statement of Energy Improvement.
7. Verify the content of the Formal Site File is complete.

Energy Tracking Plans and Procedures

The PE, or a designee working under the PE's direct supervision, is expected to visit the site or a company office where records and other relevant information can be provided to support the data verification process. The PE is not expected to conduct independent measurements or other validations of meters or other measurement devices used to generate data in the Statement of Energy Improvement.

Sites participating in the ENERGY STAR Challenge for Industry are required to establish a formal site file that includes and documents the sources of all data used to generate the site's Statement of Energy Improvement. This file must be kept at 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. A detailed description of the formal site file is provided in Appendix 2.

As part of the verification process, the PE must review the file to ensure that all the necessary information is present and that a procedure is in place to manage the data required to track achievement of the ENERGY STAR Challenge for Industry. A PE Verification Checklist is provided in Appendix 6 to ensure a comprehensive verification. Lack of information or documentation should be brought to the attention of the site contact (and corporate energy manager if the site is internationally located) who is responsible for ensuring the formal site file is complete. As a final step of the verification process, the original PE Verification Checklist and validated Statement of Energy Improvement must be added to this file.

Feedback & Questions

U.S. EPA is committed to continually improve the content of this document, and welcomes all comments that may help us do so. All applicable contact information is provided in Appendix 7.

U.S. EPA thanks you for choosing to take part in the ENERGY STAR Challenge for Industry.

1. Site Physical Characteristics & Eligibility

Objective

- Verify the site meets the definition of an industrial site.
- Verify the physical characteristics (e.g., address) and any other site-specific information displayed on a site's Statement of Energy Improvement match those of the site applying for ENERGY STAR Challenge for Industry recognition.
- Verify all data used to track energy performance is from the site named on the Statement of Energy Improvement.

Site Requirements

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 ENERGY STAR Challenge for Industry, include 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 sites within the U.S. or its territories.

Requirements of the PE

The PE must verify that the site is an industrial site and meets the site requirements previously described.

The PE must verify the accuracy of the site's recorded physical characteristics within the Statement of Energy Improvement, which include site name, location, parent company information, and contact names.

The PE must verify all data used to track energy performance is from the site named on the Statement of Energy Improvement.

Hints & Tips

NAICS codes provide definitions of major industry categories and their sub-industries. See http://www.census.gov/eos/www/naics/.

2. Operating Characteristics

Objective

- Verify all recorded non-energy operating characteristics used to calculate the site's energy intensity metric reported on the Statement of Energy Improvement.

Background

Sites participating in the ENERGY STAR Challenge for Industry are required to select an energy intensity metric, set a 10 percent reduction goal, and establish an Energy Tracking Plan that includes an energy tracking system for monitoring energy intensity over time and for identifying planned actions to undertake.

To achieve the ENERGY STAR Challenge for Industry, sites must reduce their energy intensity by 10 percent within 5 years. The baseline is a consecutive 12-month energy performance period set by the site and registered in advance with U.S. EPA. The tracking period begins immediately following the end of the baseline period and continues through the end of the period for which the 10 percent reduction is achieved. The period during which the 10 percent reduction is achieved may end no earlier than 12 months, nor more than 60 months, from the conclusion of the baseline period. The 10 percent energy intensity reduction is calculated against the baseline period for the final 12 months of the tracking period.

A site's energy intensity metric may be based on a unit of production <u>or</u> on the site's gross square footage, depending on the nature of energy use at the site and as defined in Appendix 3. In addition, sites may choose to normalize their metric for other non-energy related factors, such as weather.

U.S. EPA's approval of the energy intensity metric and the baseline (transmitted in an email to the site contact or corporate energy manager) must be a part of the formal site file.

Requirements of the PE

The PE must verify that the energy intensity metric used captures production or gross square footage for the whole site and meets the criteria described in Appendix 3.

The PE must verify for production-based energy metrics that production units used for calculating the energy intensity metric and tracked in the site's energy tracking system are consistent with numbers from official company production records.

The PE must verify for building-based metrics that the gross square footage of the site used for calculating the energy intensity metric and tracked in the energy tracking system are consistent with company records.

The PE must verify if the site's energy intensity metric is normalized for other variables, that the approach was applied consistently during the tracking period, and that the data used in the tracking system matches the original source of data used for normalization.

The PE must verify the production data or gross square footage used to calculate the energy intensity metric to ensure it is accurately accounted for in the energy tracking system.

The PE must verify any other data used for normalization.

The PE must verify that data used reflect the whole site and not a single process or individual part of the site. The PE is not expected to conduct independent measurements, but instead should consult company records and supporting documentation.

The PE must verify that all supporting documentation is included in the formal site file.

Hints & Tips

The site's Energy Tracking Plan must document the rationale for selecting the energy intensity metric used. The Energy Tracking Plan must also list the sources of all information and data used for calculating and tracking energy intensity over time.

Original specifications, design documents, and "as-built" drawings can be used to verify certain physical characteristics.

3. Energy Consumption

Objective

- Verify consumption for each type of fuel used within the site and reported on the Statement of Energy Improvement is accurate, reported in British Thermal Units (BTUs), and properly converted to source energy.

Requirements of the PE

The PE must verify that the energy intensity metric used captures energy for the whole site and meets the criteria described in Appendix 3.

The PE must review energy consumption documentation for each energy source used to operate the facility and manufacturing process at the site to ensure that all energy purchased or generated is accounted for in the energy tracked. These include energy sources such as electricity (grid purchases, on-site solar and on-site wind), natural gas, fuel oil, diesel fuel, district steam or hot water, district chilled water, propane, coal, coke, kerosene, biomass, process gases, tire-derived fuel (TDF), municipal waste, etc. The PE must also verify that the method of tracking each fuel type is consistent across the baseline and tracking periods.

The PE must verify that if a site exports electricity or steam, the quantity of these exports has been subtracted from the site's total energy use.

The PE must verify that all energy was properly converted to source energy before being aggregated.

The PE must verify the following considerations for the most common fuel sources have been met.

- Grid Electricity – When electricity is purchased from the grid, the user must 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, the user must 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. The user 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. The user 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 must 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.

All forms of energy purchased and used on site must be converted to BTUs, summed and reported on the Statement of Energy Improvement for each period during participation in the ENERGY STAR Challenge for Industry. These numbers represent the "site" energy reported on the Statement of Energy Improvement.

Next, all individual energy types must be converted from "site" energy to "source" energy. Source energy, also known as total primary energy, accounts for losses due to generation efficiency, and transmission & distribution. Ratios for converting energy use from site to source energy are provided in Appendix 4. The Quick Converter tool, provided by ENERGY STAR, converts common energy types from site energy units to source BTUs. Source data must be summed and reported on the Statement of Energy Improvement.

The PE must verify that all supporting documentation is included in the formal site file.

Hints & Tips

Review the site's Energy Tracking Plan to determine the sources of energy tracked and the primary sources of the data. Then review actual monthly energy bills, electronic billing records, and other data sources provided by the site to make sure the energy data are accounted for properly.

Energy Consumption Q&A

To verify the monthly energy consumption, must monthly bills from the utility company be independently obtained?

No. If the PE is confident based on his/her review that all of the energy sources and meters are accounted for, then independently obtained monthly utility bills are not required.

Are monthly utility bills needed to verify the monthly energy consumption of each fuel?

Not always. Based upon the judgment of the PE, a site-wide energy tracking system that fully tracks consumption of all fuels may be used instead of utility bills, particularly if that tool is integrated with an electronic billing system.

How do we handle utility bills that are not issued on a regular basis? Or bills that are issued monthly, but not consistent with a calendar month (covering first day to last day of the month)?

A plant's site-wide energy tracking system that fully tracks consumption of all energy consumption may be used instead of utility bills, though it is assumed that this system is reconciled with utility bills on a regular basis. If the plant does not have a sufficient site-wide energy tracking system, the PE should verify that consistent practices have been applied throughout the baseline and tracking period, and that these practices have been documented in the formal site file. 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.).

Should the electrical outputs of co-generation units be included as part of the site's monthly energy consumption?

No. The energy input required to operate the co-generation unit must be accounted for, but not the electricity or other energy form that is generated.

Should the electrical outputs of renewable energy (e.g. on-site solar and wind) be included as part of the total energy consumption?

Yes. Sites must report the full electric output of the renewable source if the electricity is used on site.

4. Energy Intensity Improvement

Objective

- Verify that the site has achieved the 10 percent reduction in energy intensity within 5 years from the conclusion of the baseline.

Background

Sites participating in the ENERGY STAR Challenge for Industry established a baseline of a 12-month energy performance period, and registered it in advance with U.S. EPA. They then set a 10 percent energy intensity reduction goal which must be achieved within a five year period. The tracking period begins immediately following the end of the baseline period and continues through the end of the period for which the 10 percent reduction is achieved. The period during which the 10 percent reduction is achieved may end no earlier than 12 months, nor more than 60 months, from the conclusion of the baseline period. The 10 percent energy intensity reduction is calculated against the baseline period for the final 12 months of the tracking period. An application for recognition must be submitted no later than four months after the end of the final 12 months of the tracking period.

The baseline for a site participating in the ENERGY STAR Challenge for Industry may be defined in several ways. It may be based on:

- The immediate past calendar year (e.g., a site signing up in April 2014 could set their baseline as January 1 – December 31, 2013), or
- Another consecutive 12-month period such as the most recent 12 months (e.g., a site signing up in April 2014 could set their baseline as April 1, 2013 – March 31, 2014), or
- The company's most recent fiscal year.

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

Note: Prior to 2012, sites were allowed to set a retrospective baseline of up to three years prior to the date they registered to participate in the ENERGY STAR Challenge for Industry, provided the company was an ENERGY STAR partner during that entire time. As of April 2012, this is no longer permitted, and now sites must set their baseline period as identified in Appendix 3.

Requirements of the PE

The PE must verify that the site has accurately calculated its energy intensity and energy intensity reduction.

The PE must verify that the tracking period begins immediately following the end of the baseline period and continues through the end of the period for which the 10 percent reduction is achieved.

The PE must verify that the period during which the 10 percent reduction is achieved ends no earlier than 12 months, nor later than 60 months, from the conclusion of the baseline period. The 10 percent energy intensity reduction is calculated against the baseline period for the final 12 months of the tracking period.

The ENERGY STAR Statement of Energy Improvement is provided in Microsoft Excel format and will automatically calculate energy intensity based on the energy and operating characteristics entered. However, if the site chooses to use a more complex energy metric, a multivariate energy intensity metric that has been normalized for different factors, the numbers for that metric must be entered into the Statement of Energy Improvement. In this situation, the PE must verify that correct intensity numbers were used.

The PE must verify that the energy intensity metric was correctly calculated using source energy in BTUs, and the data entered into the Statement of Energy Improvement are accurate.

5. Annual Carbon Dioxide Emissions Avoided (Optional)

Objective

- Verify that the emissions reported on the Statement of Energy Improvement were accurately calculated if a site chooses to report avoided carbon dioxide equivalent (CO_2e) emissions.

Background

Reporting avoided emissions on the Statement of Energy Improvement is optional but encouraged. Providing avoided emissions helps sites and U.S. EPA communicate the site's accomplishments in protecting the environment through improved energy performance.

Avoided CO_2e can be based on estimates using default emissions factors. Any reporting of avoided CO_2e emissions is considered voluntary. The PE is not expected to verify a site's greenhouse gas inventory nor conduct any additional measurements to determine greenhouse gas reductions.

Sites may estimate avoided greenhouse gas emissions in one of two ways:

1. Intensity basis – Sites can calculate the difference between what emissions would have been had the baseline intensity remained constant versus actual emissions at the improved performance level.

2. Absolute basis – Sites can determine the absolute reduction of greenhouse gas emissions associated with reduced energy use by subtracting the emissions from the period during which the ENERGY STAR Challenge for Industry was achieved from the emissions of the baseline period.

Sites are asked to convert emissions to CO_2e, which enables sites to account for emissions of the greenhouse gases methane (CH_4) and nitrous oxide (N_2O) emissions from the combustion of fuel. Appendix 5 provides default emissions factors for CO_2, CH_4, N_2O and guidance on converting all greenhouse gas emissions to CO_2e.

Requirements of the PE

The PE must verify that the site is using emissions factors provided by the U.S. EPA. See Appendix 5 for a list of factors. Note: If the list in Appendix 5 does not provide a particular factor, a factor from another properly documented source may be used.

The PE must verify that avoided CO_2e emissions estimates were correctly calculated.

Appendix 1: Qualifications for Professional Engineers

To verify the Statement of Energy Improvement, a licensed professional must be a Professional Engineer (PE), possess a current license in any U.S. state, Canadian Province, or territory of the U.S. or Canada, and be in good standing with any applicable licensing authorities. The PE need not necessarily be licensed in the state or country in which the subject site is located. The PE should be familiar with industrial processes and energy management. The PE may be employed by the company owning or operating the site seeking recognition, or may be a third-party contracted for verification purposes. In either case, the PE is expected to fulfill all verification requirements in a professional and unbiased manner.

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 plant'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 data or gross square footage 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 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 (CO_2e) emissions that are linked with the energy intensity reduction, all documentation supporting that the estimates were calculated correctly using proper emission factors.

Appendix 3: How to Participate

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

Step 1: Establish an energy intensity metric

An energy intensity metric must be used to track progress towards 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.[1]

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).

To learn more on how to develop an energy intensity metric for a site, please see Appendix 3 of the *ENERGY STAR Challenge for Industry Participant Handbook*.

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."

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[1] "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 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 4 of this Guide, and/or see "Understanding Source and Site Energy" and use the Quick Converter tool on the ENERGY STAR Web site.

Sites that normalize using a multivariate energy intensity metric and statistical model are permitted to use these metrics and their existing tracking method as long as they capture annual energy use. Such sites must provide the 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 2013 through March 2014) 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 2014 could set their baseline as January 1 – December 31, 2013), or
- Another consecutive 12-month period such as the most recent 12 months (e.g., a site signing up in April 2014 could set their baseline as April 1, 2013 – March 31, 2014), 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 energy use across the full twelve-month baseline period. 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/of pound product

Energy intensity reduction goal: 500 BTU/pound of product – 50 BTU/pound of product = 450 BTU/pound of product

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 the site. In the case of sites located outside the continental U.S., a copy of 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 of the *ENERGY STAR Challenge for Industry Participant Handbook* discusses information that must be included in the formal site file. The formal site file is not submitted to U.S. EPA, but will be used by the 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** located at www.energystar.gov/industrychallenge.

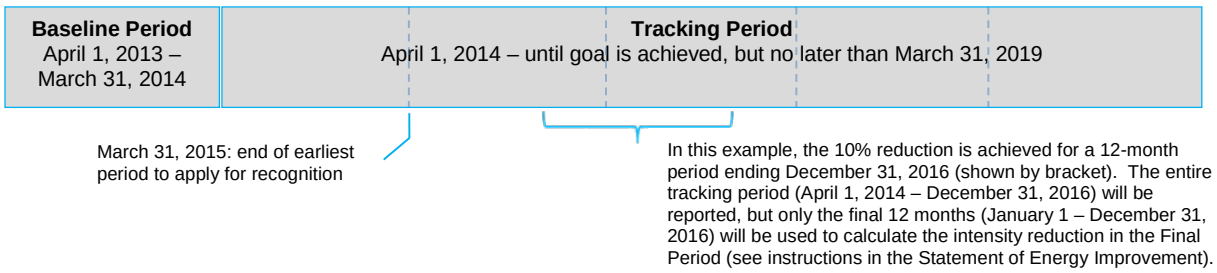
Step 6: Track energy use and achieve the 10 percent reduction

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 them at www.energystar.gov/industry.

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 2013

Site Address		**Company/Owner Address** (if different)	
Contact Name	A. Sampleson	Name	A. N. Owner
Street Address	123 Sample Way	Street Address	100 Sample Boulevard
Address 2		Address 2	
City, State	Sampleton, XX	City, State	Sampleton, XX
ZIP	12345	ZIP	12345

Energy Improvement

Period Ending:	**Baseline** March 2014	1st Year March 2015	2nd Year March 2016	3rd Year March 2017	4th Year March 2018	**Final** December 2016
Site Energy (MMBtu)	10,000	9,500	9,100			9,000
Source Energy (MMBtu)	12,000	11,400	11,000			10,900
Production Unit or Sq. Ft	1,000	1,005	1,010			1,010
Energy Intensity (MMBtu/Production Unit or Sq. Ft)	12.00	11.34	10.89	--	--	10.79
% Energy Intensity Reduction from Baseline		-5.5%	-9.2%	--	--	-10.1%
Annual Source Energy Avoided (MMBtu)		660	1,120	--	--	1,220
Annual CO_2e 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 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 is required to 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.

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.

- Review the application for completeness. Contact the applicant if any information is missing.
- Confirm the site's parent company is an ENERGY STAR partner.
- 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
- Verify that the 10% reduction goal was met within 5 years or less by reviewing the data contained in the Statement of Energy Improvement.
- Verify that the tracking period data in the Statement of Energy Improvement began immediately following the end date of the baseline period.
- 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.
- 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.

Appendix 4: Source-Site Energy Ratios

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.

Appendix 5: Default Emissions Factors

The following tables include default emissions factors used by the U.S. EPA.

Emissions from Electricity

Emissions associated with electricity purchased from the U.S. electrical grid should be calculated using a regional emission factor from the U.S. EPA's eGRID database available online at http://cfpub.epa.gov/egridweb/ghg.cfm.

Sites should identify their eGRID region using the map on that web page, select the annual output emission rates for that region, and convert to CO_2e.

Emissions from Fuel

Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor
Coal and Coke	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Anthracite	25.09	103.54
Bituminous	24.93	93.40
Subbituminous	17.25	97.02
Lignite	14.21	96.36
Coke	24.80	102.04
Mixed (Commercial sector)	21.39	95.26
Mixed (Industrial coking)	26.28	93.65
Mixed (Industrial sector)	22.35	93.91
Mixed (Electric Power sector)	19.73	94.38
Natural Gas	**mmBtu/scf**	**kg CO_2 /mmBtu**
Pipeline (Weighted U.S. Average)	1.028×10^{-3}	53.02
Petroleum Products	**mmBtu/gallon**	**kg CO_2 /mmBtu**
Distillate Fuel Oil No. 1	0.139	73.25
Distillate Fuel Oil No. 2	0.138	73.97
Distillate Fuel Oil No. 4	0.146	75.06
Residual Fuel Oil No. 5	0.140	72.95
Residual Fuel Oil No. 6	0.150	78.12
Still Gas/Refinery Gas	0.143	66.73
Kerosene	0.135	72.36
Liquefied Petroleum Gases (LPG)	0.092	62.98
Propane	0.091	63.03
Propylene	0.091	67.78
Ethane	0.096	62.64
Ethylene	0.100	67.45
Isobutane	0.103	65.39
Isobutylene	0.103	67.74
Butane	0.101	65.18
Butylene	0.103	67.73
Naphtha (<401 deg F)	0.125	68.04
Natural Gasoline	0.110	66.83
Other Oil (>401 Deg F)	0.139	76.40
Pentanes Plus	0.110	69.24
Petrochemical Feedstocks	0.129	70.97
Petroleum Coke	0.143	102.45

Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor
Special Naphtha	0.125	72.32
Unfinished Oils	0.139	74.49
Heavy Gas Oils	0.148	74.90
Lubricants	0.144	74.27
Motor Gasoline	0.125	70.22
Aviation Gasoline	0.120	69.66
Kerosene-Type Jet Fuel	0.135	72.61
Asphalt and Road Oil	0.158	75.38
Crude Oil	0.138	74.49
Fossil Fuel-derived Fuels (Solid)	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Municipal Solid Waste (units that do not generate steam)	9.95	90.7
Tires	26.87	85.
Fossil Fuel-derived Fuels (Gaseous)	**mmBtu/scf**	**kg CO_2 /mmBtu**
Blast Furnace Gas	0.092×10^{-3}	274.32
Coke Oven Gas	0.599×10^{-3}	46.85
Biomass Fuels – Solid	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Wood and Wood Residuals	15.38	93.80
Agricultural Byproducts	8.25	118.17
Peat	8.00	111.84
Solid Byproducts	25.83	105.51
Biomass Fuels – Gaseous	**mmBtu/scf**	**kg CO_2 /mmBtu**
Biogas (Captured methane)	0.841×10^{-3}	52.07
Biomass Fuels – Liquid	**mmBtu/gallon**	**kg CO_2 /mmBtu**
Ethanol (100%)	0.084	68.47
Biodiesel (100%)	0.128	73.84
Rendered Animal Fat	0.125	71.04
Vegetable Oil	0.120	81.53

Default CH_4 and N_2O Emission Factors for Various Types of Fuel

Fuel Type	Default CH_4 Emission Factor (kg CH_4/mmBtu)	Default N_2O Emission Factor (kg N_2O/mmBtu)
Coal and Coke	1.1×10^{-02}	1.6×10^{-03}
Natural Gas	1.0×10^{-03}	1.0×10^{-04}
Petroleum	3.0×10^{-03}	6.0×10^{-04}
Fossil Fuel-derived Fuels	3.2×10^{-02}	4.2×10^{-03}
Blast Furnace Gas	4.8×10^{-04}	1.0×10^{-04}
Coke Oven Gas	2.2×10^{-05}	1.0×10^{-04}
Biomass Fuels - Solid	3.2×10^{-02}	4.2×10^{-03}
Biomass Fuels - Gaseous	3.2×10^{-03}	6.3×10^{-04}
Biomass Fuels – Liquid	1.1×10^{-03}	1.1×10^{-04}

Converting to Metric Tons of CO_2e

1. Determine the total emissions of CO_2, CH_4, N_2O from fossil fuel combustion.

2. Convert all emissions to metric tons, if necessary. 1 kilogram = 0.001 metric tons

3. Calculate metric tons of CO_2e using the following equation:

$$CO_2e = \sum_{i=1}^{n} GHG_i \times GWP_i$$

Where:

CO_2e	=	Carbon dioxide equivalent, metric tons/year.
GHG_i	=	Mass emissions of each greenhouse gas metric tons/year.
GWP_i	=	Global warming potential for each greenhouse gas (see table below).
n	=	The number of greenhouse gases emitted.

Common Name	Chemical formula	Global warming potential (100 yr.)
Carbon dioxide	CO_2	1
Methane	CH_4	21
Nitrous oxide	N_2O	310

Appendix 6: PE Verification Checklist

Site name and address:_____
_____

Date: _____

Name of PE completing this form:_____

Review location: Corporate Office ___ Site Visit ___

Site Physical Characteristics and Eligibility

- ☐ The site has established a formal site file. Yes___ No___
  - ☐ Location of the formal site file:_____
- ☐ The site meets the definition of an industrial site defined in the site requirements. Yes___ No___
- ☐ 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) match that of the site applying for the ENERGY STAR Challenge for Industry recognition. Yes___ No___

Site Operating Characteristics

- ☐ The site's registered baseline and energy intensity metric were approved by U.S. EPA. Yes___ No___
- ☐ The data used to track the energy performance of the site is from the site named on the Statement of Energy Improvement. Yes___ No___
- ☐ All information supporting the non-energy operating characteristics used to calculate the site's energy intensity metric is documented. Yes___ No___
- ☐ 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. Yes___ No___
- ☐ All data was tracked consistently throughout the duration of participating in the ENERGY STAR Challenge for Industry. Yes___ No___
- ☐ For production-based energy metrics, the production units used for calculating the energy intensity metric are consistent with the numbers from the official company production records. Yes___ No___
- ☐ For building-based energy metrics, the gross square footage of the site used for calculating the energy intensity metric are consistent with company records. Yes___ No___
- ☐ For complex energy metrics, the approach was applied consistently during the tracking period and the data used matches the origin of the original normalized/multivariate data used to develop the metrics. Yes___ No___
- ☐ The production, gross square footage and/or normalized data used to calculate the energy intensity match the data found in the site's energy tracking system. Yes___ No___
- ☐ All data used reflects the whole facility and not a single process or individual part of the site. Yes___ No___

Site Energy Consumption

- ☐ 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. Yes___ No___
- ☐ All information supporting the energy consumption used to calculate the site's energy intensity metric is documented. Yes___ No___
- ☐ All information supporting the energy consumption used to calculate the site's energy intensity metric is treated consistently across the baseline and tracking periods, especially for energy sources that may be invoiced at irregular (non-monthly) intervals. Yes___ No___
- ☐ If site exports electricity or steam, these exports have been subtracted from the site's total energy use. Yes___ No___ N/A, site does not export._____
- ☐ All forms of energy purchased and used on site were properly converted to BTUs, summed and reported on the Statement of Energy Improvement as site energy. Yes___ No___
- ☐ All energy was properly converted from "site" to "source" energy, summed and reported on the Statement of Energy Improvement as source energy. Yes___ No___
- ☐ All data used reflects the whole facility and not a single process or individual part of the site. Yes___ No___

Site Energy Intensity Improvement

- ☐ 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. Yes___ No___
  If no, an explanation for the difference must be noted in this checklist (below), accompanied by any necessary supporting documentation.
- ☐ 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 in the Statement of Energy Improvement. Yes___ No___
- ☐ The period during which the energy intensity reduction was achieved ends no earlier than 12 months, nor later than 60 months, from the conclusion of the baseline period. The 10 percent energy intensity reduction is calculated against the baseline period for the final 12 months of the tracking period. Yes___ No___
- ☐ The tracking period begins immediately following the end of the baseline period and continues through the end of the period for which the 10 percent reduction is achieved. Yes___ No___

Site Annual Carbon Dioxide Emissions Avoided (Optional)

- ☐ If site has reported the avoided carbon dioxide equivalent (CO_2e), the emission estimates that are linked with the energy intensity reduction were calculated correctly using proper emission factors. Yes___ No___ N/A, site has not reported CO2e.____

Completion of Formal Site File

- ☐ All documentation/calculations supporting all the statements above are located in the formal site file. Yes___ No___

PE Verification

- ☐ The PE completed the PE Verification Checklist for submission to U.S. EPA, and added the original document to the formal site file. Yes___ No___
- ☐ The PE validated the Statement of Energy Improvement (includes: signing, stamping – indicating if embossed, and providing the required license information) for submission to U.S. EPA, and added the original document to the formal site file. Yes___ No___

Please note any company personnel involved in review:_____
_____
_____

Please note any findings, corrections, or recommendations from the review:
_____
_____
_____
_____
_____

Appendix 7: 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