



ENERGY STAR® Program Requirements for Geothermal Heat Pumps Version 3.0

Partner Commitments – Final Draft

Note: The revisions presented in this Final Draft Version 3.0 specification are based on stakeholder comments received on the previous Draft 1 proposal. To facilitate and expedite the review process, EPA has tracked key proposed editorial changes throughout the document in red font. All interested stakeholders are encouraged to provide additional feedback and suggestions to ghps@energystar.gov by **November 23, 2009**. Stakeholder comments can be viewed on the ENERGY STAR Web site at: www.energystar.gov/revisedspecs.

Commitment

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing of ENERGY STAR qualified geothermal heat pumps. The ENERGY STAR Partner must adhere to the following program requirements:

- comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be met for use of the ENERGY STAR certification mark on geothermal heat pumps and specifying the testing criteria for geothermal heat pumps. EPA may, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at EPA's request;
- comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR marks and name may be used. Partner is responsible for adhering to these guidelines and for ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance;
- qualify at least one ENERGY STAR labeled geothermal heat pump model within one year of activating the geothermal heat pumps portion of the agreement. When Partner qualifies the product, it must meet the specification (e.g., Tier 1 or 2) in effect at that time;
- provide clear and consistent labeling of ENERGY STAR qualified geothermal heat pumps. The ENERGY STAR mark must be clearly displayed in product literature (i.e., user manuals, spec sheets, etc.) and on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed. It is also recommended that the mark appear on the top/front of the product and on the product packaging;
- offer and encourage training to distributors and/or contractors on the following issues: proper equipment installation and hookup, distribution systems and their effect on performance, proper domestic water heater connection for desuperheater or demand water heating, code compliance, and proper use of the Manual J calculation, or other equivalent calculation, in order to encourage proper sizing of equipment. In addition, Partner should strive to use contractors or loop installers who have received training on the design and installation of the ground heat exchanger and that provide warranty protection for the integrity and performance of the ground heat exchanger for at least two years. Ground heat exchanger training may be provided by Partner or a well regarded training program. Partner shall focus its ENERGY STAR marketing efforts in regions where contractors and loop installers have received training and provide warranties;

Note: It was brought to EPA's attention that there are other organizations, such as the National Ground Water Association, that offer geothermal heat exchanger training. Instead of attempting to list multiple third party training organizations, EPA has removed the previous reference to the International Ground Source Heat Pump Association.

- offer a means to provide some or all of the domestic water heating through the use of a desuperheater, integrated demand water heater, or stand-alone demand water heating model. Partner will strive to ensure that customers, distributors, and contractors are aware of the benefits of using a geothermal heat pump system to provide water heating in its marketing materials, installation manuals, and training programs;
- provide to EPA, on an annual basis, an updated list of ENERGY STAR qualifying geothermal heat pump models. Once the Partner submits its first list of ENERGY STAR qualified geothermal heat pumps, the Partner will be listed as an ENERGY STAR Partner. Partner must provide annual updates in order to remain on the list of participating product manufacturers;
- provide to EPA, on an annual basis, unit shipment data or other market indicators to assist in determining the market penetration of ENERGY STAR. Specifically, Partner must submit the total number of ENERGY STAR qualified geothermal heat pumps shipped (in units by model) or an equivalent measurement as agreed to in advance by EPA and Partner. Partner is also encouraged to provide ENERGY STAR qualified unit shipment data segmented by meaningful product characteristics (e.g., capacity, size, speed, or other as relevant), total unit shipments for each model in its product line, and percent of total unit shipments that qualify as ENERGY STAR. The data for each calendar year should be submitted to EPA, preferably in electronic format, no later than the following March and may be provided directly from the Partner or through a third party. The data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner; and
- notify EPA of a change in the designated responsible party or contacts for geothermal heat pumps within 30 days.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures and should keep EPA informed on the progress of these efforts:

- consider energy efficiency improvements in company facilities and pursue the ENERGY STAR mark for buildings;
- purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes;
- ensure the power management feature is enabled on all ENERGY STAR qualified monitors in use in company facilities, particularly upon installation and after service is performed;
- provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified product models;
- feature the ENERGY STAR mark(s) on Partner Web site and in other promotional materials. If information concerning ENERGY STAR is provided on the Partner Web site as specified by the ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to

the Partner Web site;

- provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that Partner would like EPA to be aware of. For example, activities may include: (1) increase the availability of ENERGY STAR labeled products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) provide information to users (via the Web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products, and (4) build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event;
- provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message;
- join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway;
- join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders; and
- join EPA's Green Power partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities, visit <http://www.epa.gov/grnpower>.



145

ENERGY STAR® Program Requirements for Geothermal Heat Pumps Version 3.0

Eligibility Criteria – Final Draft

Below is the **Final Draft** Version 3.0 product specification for ENERGY STAR qualified geothermal heat pumps. A product must meet all of the identified criteria if it is to be labeled as ENERGY STAR by its manufacturer.

1) Definitions: Below are the definitions of the relevant terms in this document.

A. Geothermal Heat Pump: A geothermal heat pump uses the thermal energy of the ground or groundwater to provide residential space conditioning and/or domestic water heating. A geothermal heat pump model normally consists of one or more factory-made assemblies that include indoor conditioning and/or domestic water heat exchanger(s), compressors, and a ground-side heat exchanger. A geothermal heat pump model may provide space heating, space cooling, domestic water heating, or a combination of these functions and may also include the functions of liquid circulation, thermal storage, air circulation, air cleaning, dehumidifying or humidifying. A geothermal heat pump system generally consists of one or more geothermal heat pump models, the ground heat exchanger(s), the air and/or hydronic space conditioning distribution system(s), temperature controls, and thermal storage tanks.

B. Single-Stage: Geothermal heat pumps that are designed to operate at one stage and one capacity.

C. Multi-Stage: Geothermal heat pumps that are designed to operate at more than one stage or capacity through the use of technologies such as multiple stage compressors, dual compressors, variable speed compressors, etc. Multi-stage models are more efficient while running at lower capacities, but have the capability to supply more heating or cooling using higher capacities when required.

D. Ground Heat Exchanger: The method by which heat is exchanged with the ground, groundwater or surface water. Geothermal heat pumps may use any form of ground heat exchange, which includes horizontal, vertical or submerged surface water closed loops; open loops using ground water, reclaimed water, or surface water; or direct refrigerant-to-ground or **refrigerant-to-water** heat exchange.

E. Closed Loop: A ground heat exchange method in which the heat transfer fluid is permanently contained in a closed piping system. Also called a *ground-loop* system.

F. Open Loop: A ground heat exchange method in which the heat transfer fluid is part of a larger environment. The most common open loop systems use ground water, reclaimed water, or surface water as the heat transfer medium. Also called a *ground-water* system.

G. Water-to-Air: A geothermal heat pump model that provides space conditioning primarily by the use of an indoor air heat exchange coil. Water-to-air models may also provide domestic water heating and hydronic space heating by using desuperheater and/or demand water heating functions.

H. Water-to-Water: A geothermal heat pump model that provides space conditioning and/or domestic water heating by the use of indoor refrigerant-to-water heat exchanger(s). Water-to-water models may provide domestic water heating by using desuperheater and/or demand water heating functions.

I. Direct Geoexchange (DGX): A geothermal heat pump model in which the refrigerant is circulated in pipes buried in the ground or submerged in water which exchanges heat with the ground, rather than using a secondary heat transfer fluid, such as water or antifreeze solution in a separate closed loop.

Note: It was brought to EPA's attention that there are direct geoexchange technologies available today that use water baths for direct heat exchange instead of the ground. According to industry sources, these types of units are able to be tested under AHRI 870 provided the water is not being pumped, as the pump energy would not be accounted for under AHRI 870. Therefore, EPA is considering allowing these products into the program and has therefore proposed modifications to the DGX and Ground Heat Exchanger definitions, above.

J. Desuperheater: A partial heat recovery system that captures heat from the hot refrigerant gas as it leaves the heat pump compressor and transfers it to the domestic hot water. Desuperheaters provide hot water only while the heat pump is providing space conditioning.

K. Demand Water Heating: Demand geothermal heat pump water heating models provides all, or nearly all, of the domestic hot water needs even when space conditioning is not required. This may be accomplished by either stand-alone domestic water heating models or integrated models that use the same compressor for both space conditioning and domestic water heating. This product type is sometimes referred to as *dedicated* or *full-time* water heaters.

L. Coefficient of Performance (COP): A measure of efficiency in the heating mode that represents the ratio of total heating capacity to electrical energy input. For the purpose of this specification, COP will be calculated for Closed Loop and Open Loop systems in accordance with the International Standards Organization (ISO) Test Standard 13256-1 or 13256-2 as stated in Section 4 below. For DGX systems, COP will be calculated in accordance with the Air-Conditioning Heating, and Refrigeration Institute (AHRI) 870 conditions.

M. Energy Efficiency Ratio (EER): A measure of efficiency in the cooling mode that represents the ratio of total cooling capacity to electrical energy input. For the purpose of this specification, EER will be calculated for Closed Loop and Open Loop systems in accordance with ISO 13256-1 or 13256-2 as stated in Section 4 below. For DGX systems, EER will be calculated in accordance with AHRI 870 conditions.

N. Manual J Calculation: A calculation performed to determine the heating load for a residence or small commercial building. The calculation shall include site-specific characteristics such as regional weather data, building framing materials, building insulation levels, building air infiltration levels, and window area. The calculation follows procedures and protocols developed by the Air Conditioning Contractors of America (ACCA).¹

O. Manufacturer Limited Warranty: Manufacturer limited warranty is an assurance by the Partner that purchased equipment is warranted for a certain required amount of time. The exact terms of the limited warranty, given the minimum specifications, shall be determined by the Partner.

- 2) **Qualifying Products**: For purposes of ENERGY STAR qualification, geothermal heat pumps include the following: open loop, closed loop, and DGX that are powered by single phase current. The specifications in Section 3 apply to single stage models. Multi-stage models may be qualified based on $EER = (\text{highest rated capacity EER} + \text{lowest rated capacity EER})/2$; and $COP = (\text{highest rated capacity COP} + \text{lowest rated capacity COP})/2$. **Note: Commercial (i.e., 3-phase) units are not eligible for qualification under this ENERGY STAR Version 3.0 specification at this time.**

¹ Air Conditioning Contractors of America (ACCA), 2800 Shirlington Road, Suite 300, Arlington, VA 22206.

Note: In response to EPA's request regarding commercial geothermal heat pumps in the Draft 1, a few stakeholders expressed interest in expanding the ENERGY STAR geothermal heat pump program to commercial units. EPA was initially interested in possibly adding commercial units under this Version 3.0 only if the requirements remained unchanged as compared to residential units. However, EPA has since learned that there are enough nuances with commercial designs and applications that a separate analysis would need to be performed prior to inclusion in the ENERGY STAR program. Therefore, EPA has excluded commercial units (i.e., 3-phase) from this Version 3.0 specification and will work with manufacturers to learn more about the market and technologies over the next several months to determine how they might be addressed under the ENERGY STAR program.

One stakeholder asked EPA to consider addition of VRF multi-split GHPs. EPA understands that these systems are primarily intended for commercial application. As noted above, commercial GHPs are more complex systems and further analysis would need to be done in order to include these models. In addition, no data on these units have been provided to EPA throughout the specification revision process. EPA understands that performance data on these products is limited and not generally available. Therefore, at this time, EPA has not included these VRF systems in the scope of this specification. EPA is interested in learning more about these products and may decide to include them longer term. Manufacturers are encouraged to provide performance data for VRF multi-split GHPs to help inform EPA on possible inclusion of these units in a future specification.

- 3) **Efficiency Requirements for Qualifying Products:** Only those product types listed in Section 2 that meet the criteria below may qualify as ENERGY STAR.

Table 1: Tier 1 Requirements (December 1, 2009)		
Product Type	EER	COP
Water-to-Air		
Closed Loop Water-to-Air	14.1	3.3
Open Loop Water-to-Air	16.2	3.6
Water-to-Water		
Closed Loop Water-to-Water	15.1	3.0
Open Loop Water-to-Water	19.1	3.4
DGX		
DGX	15.0	3.5

Table 2: Tier 2 Requirements (January 1, 2011)		
Product Type	EER	COP
Water-to-Air		
Closed Loop Water-to-Air	16.1	3.5
Open Loop Water-to-Air	18.2	3.8
Water-to-Water		
Closed Loop Water-to-Water	15.1	3.0
Open Loop Water-to-Water	19.1	3.4
DGX		
DGX	16.0	3.6

Table 3: Tier 3 Requirements (January 1, 2012)		
Product Type	EER	COP
Water-to-Air		
Closed Loop Water-to-Air	17.1	3.6
Open Loop Water-to-Air	21.1	4.1
Water-to-Water		
Closed Loop Water-to-Water	16.1	3.1
Open Loop Water-to-Water	20.1	3.5
DGX		
DGX	16.0	3.6

Note: One stakeholder had questions about the proposed levels in Tables 1-3, specifically that the percentage increase in stringency between tiers across all technologies was inconsistent. EPA proposed levels are based on data from the AHRI Certified Directory and from additional data supplied to EPA. Both sources were considered to ensure that ENERGY STAR represents the top performers available in the marketplace in terms of energy efficiency. EPA generally sets performance levels based on available data rather than choosing levels based on a predetermined percentage increase over the existing specification requirements (e.g., setting a level that is 15% higher than the Version 2.0 levels). When determining levels, EPA also considered the availability of products from multiple manufacturers to allow for greater consumer choice.

EPA will implement the Tier 2 and 3 requirements to refine the specification and to provide manufacturers with key long term timelines. EPA believes that the energy savings combined with the federal tax incentives make for a favorable payback period for the higher efficiency units represented by this specification and its future tiers.

- 4) **Warranty Requirements:** Partner must provide, as standard, a manufacturer limited warranty for its ENERGY STAR qualified geothermal heat pump models for all parts and labor for a minimum of two years. The major refrigerant circuit components, including the compressor(s), heat exchanger(s), and expansion and reversing valve(s) will be warranted for parts and labor for a minimum of five years.
- 5) **Test Criteria:** Partner is required to perform tests and self-certify those product models that meet the ENERGY STAR guidelines. The test results must be reported to EPA using the Geothermal Heat Pump Qualifying Product Information (QPI) Form. When testing geothermal heat pumps, the partner must use the following test procedures to determine ENERGY STAR compliance:
 - A. Closed Loop: Systems shall qualify under rating conditions in accordance with ISO 13256-1 for water-to-air models or ISO 13256-2 for water-to-water models.
 - B. Open Loop: Systems shall qualify under rating conditions in accordance with ISO 13256-1 for water-to-air models or ISO 13256-2 for water-to-water models.
 - C. DGX: Systems shall qualify under rating conditions in accordance with AHRI 870.
- 6) **Tier 2 Product Certification Requirements (Effective January 1, 2011):** To participate in the ENERGY STAR program, each model must be certified by AHRI or another such organization as approved by EPA (see Section 7, Requirements of Organizations Certifying Products for ENERGY STAR). Certification testing includes both initial qualification testing, as well as ongoing verification testing. Certification testing must be conducted according to the Test Criteria described in Section 5.

- 7) **Requirements of Organizations Certifying Products for ENERGY STAR:** This specification does not grant any organization the exclusive right to certify the performance of a geothermal heat pump for ENERGY STAR qualification. EPA will maintain a list of organizations authorized under this specification. As EPA approves certification organizations, it will add them to this list. **Certification organizations are encouraged to implement quality control guidelines for operating certification systems, such as those guidelines described in ISO/IEC Guide 65:1996 - General requirements for bodies operating product certification systems.** EPA will consider the following elements when reviewing a certification organization for inclusion on this list:

Note: One stakeholder requested that EPA require certification organizations be accredited to ISO 65. In this specification, EPA is including text that encourages certification organizations to implement quality control guidelines, such as the guidelines described in ISO/IEC Guide 65:1996, to ensure that the certification organization has a quality control process in place. While some organizations already have the ISO 65 accreditation, EPA recognizes that many well-regarded third-party certification organizations are currently not accredited to this standard. Therefore, EPA is encouraging certification organizations to implement quality control procedures, such as those described in ISO 65.

A. Laboratory Requirements:

Laboratory accreditation: To test geothermal heat pumps under this specification, the certification organization must ensure that all ENERGY STAR models are tested by an independent 3rd party laboratory that is accredited by an accreditation body that is a signatory, in good standing, to a mutual recognition arrangement of a laboratory accreditation cooperation (i.e. ILAC², APLAC³, etc.) that verifies, by evaluation and peer assessment, that its signatory members are in full compliance with ISO/IEC 17011 and that their accredited laboratories comply with ISO/IEC 17025. Laboratories must be specifically qualified to carry out tests to determine whether geothermal heat pumps meet the key performance criteria as outlined in this document. A laboratory's Scope of Accreditation must reflect its specific competence to carry out the test procedures referenced in Section 5 of this specification.

B. Verification procedure requirements:

1. The organization shall have in place a verification testing procedure.
2. Product procurement: Products to undergo verification testing shall be procured from the marketplace. In order to ensure the organization's ability to procure a production unit, the organization shall not inform the Partner which models will be tested or where they will be obtained. Where this is not possible, and the products must be procured from the Partner, the organization shall ensure the samples are randomly selected from the production line.
3. Frequency of testing, and number of products to be tested: The organization shall ensure that at least 90% of each Partner's certified base model products that are ENERGY STAR qualified undergo verification testing every three years. The proportion or number of a Partner's products to be tested annually may be determined by the certification organization.
4. Resolution of failures: The organization shall have in place a procedure to resolve product failures, and provide EPA with details of this procedure.

C. Challenge procedure requirements:

1. The organization shall have in place a challenge testing procedure.

² International Laboratory Accreditation Cooperation

³ Asia Pacific Laboratory Accreditation Cooperation

2. Product procurement and resolution of failures shall follow Section 7.B, Verification procedure requirements.

Note: One stakeholder asked EPA to include more specific challenge procedure requirements. However, EPA recognizes that different certification organizations may have different protocols for challenge testing. EPA's intent is to simply require that a detailed challenge testing protocol be in place to help ensure compliance without prescribing the means in detail. Therefore, EPA is not setting specific requirements for challenge testing at this time. However, as these certification organizations are subject to EPA approval, EPA reserves the right to review the challenge procedures of the certification organization as part of the approval process to ensure that testing protocols are comprehensive, rigorous, and non-biased.

- D. Certification of base-derived or similar products: The certification organization shall not certify an ENERGY STAR qualified product based on the ratings of another product unless the differences between the two products are limited to those that do not adversely affect product performance. Examples of acceptable differences include but are not limited to color, finish, and nameplate.
- E. Membership requirements: The organization shall not require that a party seeking product certification be a member of the organization. Product verification and challenge testing shall only require that the product has been certified by the organization.
- F. Consideration of the organization's procedures: The certification, verification, and challenge testing procedures, as well as all other relevant aspects of any certification organization, must be available in written format to current or prospective ENERGY STAR geothermal heat pump program Partners, and must be submitted in this format to EPA for its review.
- G. Reporting results to EPA: The certification organization shall report to EPA on an annual basis the outcomes of verification and challenge testing for all ENERGY STAR qualified products certified by the organization. Data reporting shall follow the rounding and reporting rules included in the applicable test standard referenced in Section 4.
- 8) Effective Date: The date that products must meet the requirements specified under the Version 3.0 geothermal heat pump specification will be defined as the effective date of the agreement.
- A. Tier 1 Requirements: The first phase of this specification will commence on **December 1, 2009**. All products, including models originally qualified under the previous Version 2.0 specification, with a date of manufacture on or after **December 1, 2009**, must meet the new Version 3.0 Tier 1 requirements in order to qualify for ENERGY STAR. The date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is considered to be completely assembled.
- B. Tier 2 Requirements: The second phase of this specification, Tier 2, shall commence on **January 1, 2011**. All products, including models originally qualified under Tier 1, with a date of manufacture on or after **January 1, 2011** must meet the new Tier 2 requirements in order to qualify for ENERGY STAR.
- C. Tier 3 Requirements: The third phase of this specification, Tier 3, shall commence on **January 1, 2012**. All products, including models originally qualified under Tier 2, with a date of manufacture on or after **January 1, 2012**, must meet the new Tier 3 requirements in order to qualify for ENERGY STAR.
- D. Elimination of Grandfathering: EPA will not allow grandfathering under this Version 3.0 ENERGY STAR specification. **ENERGY STAR qualification under previous Versions is not automatically granted for the life of the product model.** Therefore, any product sold, marketed, or identified by the manufacturing partner as ENERGY STAR must meet the current specification in effect at the time of manufacture of the product.

Note: Based on stakeholder input, and to allow partnering manufacturers sufficient time to transition to the new Tier 2 requirements, EPA is proposing a new Tier 2 effective date of January 1, 2011 in this Final Draft. Previously in Draft 1, EPA proposed an August 1, 2010 effective date. This new Tier 2 effective date provides manufacturers a little over one year to transition to the new requirements for water-to-air and DGX models. On January 1, 2011, Tier 2 will replace Tier 1. At that time, any geothermal heat pump that does not meet the Tier 2 requirements will be removed from the ENERGY STAR qualified product list. Tier 2 requirements will remain unchanged for water-to-water units. No changes have been proposed to the Tier 3 effective date. EPA will track the geothermal heat pump market to ensure that the Tier 3 levels continue to be appropriate prior to taking effect on January 1, 2012.

- 9) Future Specification Revisions:** EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model. To carry the ENERGY STAR mark, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture.