Wisconsin Contractors Institute

ENERGY SAVING SYSTEMS FOR RESIDENTIAL CONSTRUCTION

Course Number 962654
2 CE Hours

Wisconsin Contractors Institute

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INTRODUCTION

This course is designed to help students better understand the importance of green initiatives, the difference between global warming and climate change, the definition of a carbon footprint, and the issue of using fossil fuels. The course will also help learners recognize the value of employing renewable energy initiatives. Throughout this course, you will be able to understand what the requirements are for constructing Energy Star homes and the benefits of doing so. You will also learn about the various energy-efficient systems you can employ in your building practices.

Learning Objectives

1. Learners will be able to differentiate between "Green Initiatives", global warming, climate change, carbon footprint, and fossil fuel use.
2. Learners will be able to explore the value of employing renewable energy initiatives as contractors and be able to explain the requirements for constructing Energy Star Homes.
3. Learners will be to describe various energy-efficient systems that can be employed in building practices.

There is a lot of debate throughout the world and particularly throughout the United States regarding the importance of the green initiative. Although opinions vary, it has become a generally accepted belief that the concept of going green is important. Going green is the belief that adopting environmentally friendly practices and policies is worth prioritizing. Let's look at how we as general contractors can play a part and explore some of the significant reasons why going green is important.

In a recent article entitled "A Review of Carbon Footprint Reduction in the Construction Industry," a writer revealed the following information: "the construction industry is listed as the single largest global consumer of resources. Globally in developed and developing countries, buildings contribute to 33% of greenhouse gas emissions and 40% of the global energy consumption which stem from the usage of equipment, the manufacturing of building materials and transportation."

Environmental Conservation

Let's look at some of the arguments as to why it's believed that going green is important. Going green is important for environmental conservation. Going green helps protect the planet and its natural resources. It reduces the negative impact of human activities on ecosystems, wildlife, and the overall environment. By minimizing pollution, conserving water, and preserving biodiversity, we can maintain a healthier planet for current and future generations.

Going green also helps mitigate climate change. Many environmentally friendly practices strive to reduce greenhouse gas emissions which are a primary driver of climate change caused by increasing carbon dioxide levels and other dangerous emissions. Transitioning to cleaner energy sources, reducing energy consumption, and promoting sustainable transportation can help mitigate the effects of global warming. Going green also means developing methods to increase energy efficiency throughout the world. Energy efficient technologies and practices not only reduce energy bills but also decrease the demand for fossil fuels. This in turn lowers greenhouse gas emissions and contributes to a more sustainable energy future. By adopting sustainable practices, we can ensure the availability of these resources for the long-term. Green initiatives often result in cleaner air and water, which can improve public health. By reducing air pollution and exposure to harmful chemicals, we can realize lower rates of respiratory illness, cardiovascular diseases, and other health-related problems. Green initiatives can also lead to increased economic opportunities, including job creation and economic growth opportunities. Investments in renewable energy, energy efficiency and sustainable agriculture can generate employment and stimulate innovation. Sustainable practices such as recycling and composting reduce waste sent to landfills and promote energy efficiency. This helps conserve raw materials and reduces the environmental impact of waste disposal.

Introduction – REVIEW QUESTIONS

1. What is the primary goal of "going green"?

A. Increasing the use of fossil fuels
B. Protecting the planet and its natural resources
C. Reducing the cost of construction materials
D. Promoting urbanization

2. According to the article "A Review of Carbon Footprint Reduction in the Construction Industry," what percentage of global greenhouse gas emissions is attributed to buildings?

A. 25%
B. 33%
C. 40%
D. 50%

3. Which of the following is NOT a benefit of green initiatives?

A. Cleaner air and water
B. Job creation and economic growth
C. Reduced greenhouse gas emissions
D. Increased energy consumption

4. What will learners be able to do after completing this course?

A. Identify the differences between global warming and climate change
B. Explain the requirements for constructing Energy Star Homes
C. Describe energy-efficient systems for building practices
D. All of the above

5. How does going green help mitigate climate change?

A. By increasing the use of fossil fuels
B. By promoting deforestation
C. By reducing greenhouse gas emissions
D. By increasing energy consumption

CARBON FOOTPRINT

Now that we better understand green initiatives and the concept of going green, let's spend a few minutes defining and discussing the carbon footprint. A carbon footprint is often discussed when exploring the environmental impact of the things that we do and the way that we live.

A carbon footprint is a measure of the total amount of greenhouse gases, primarily carbon dioxide (CO2) and other carbon compounds, that are emitted directly or indirectly by an individual, organization, event, or product over a specific period. It is usually expressed in units of carbon dioxide equivalent represented as (CO2e), which considers the global warming potential of the different greenhouse gases.

The concept of a carbon footprint is used to assess the environmental impact of various human activities and to quantify their contribution to climate change. There are a few common sources of carbon emissions that contribute to an individual or entity's carbon footprint. The burning of fossil fuels (coal, natural gas, and oil) to generate electricity, heating, and transportation are all a major source of carbon emissions. Transportation is also a significant contributor to our carbon footprint the use of gasoline and diesel fuels in cars, trucks, airplanes, and ships all create carbon emissions. Other contributors to the carbon footprint involve the production of food, manufacturing and industrial processes, specifically items which directly concern us as general contractors are the production of steel, cements and plastics. Waste management and landfills are also large contributors to the carbon footprint, therefore the less waste we have at jobsites the better.

Carbon Footprint – REVIEW QUESTIONS

6. What does a carbon footprint measure?

A. The total amount of greenhouse gases emitted directly or indirectly

B. The amount of water used by an individual or organization

C. The energy efficiency of a building or product

D. The amount of waste generated at a job site

7. Which of the following is NOT a common source of carbon emissions?

A. Burning fossil fuels for electricity and heating

B. Transportation using gasoline and diesel fuels

C. The production of steel, cement, and plastics

D. The use of renewable energy sources like solar and wind

GLOBAL WARMING VS. CLIMATE CHANGE

As discussed previously, contributing to the carbon footprint and our failure to adopt green initiatives can contribute to global warming and climate change. We will now focus on discussing what global warming and climate change are and the differences in the two.

First off, let's define climate change. We start with the definitions for climate and weather, which are sometimes confused.

- Climate: long-term weather patterns
- Weather: Locally occurring over a short time such as rain or snow.

Climate change is a long-term change in the average weather patterns that define Earth's local, regional, and global climates. These changes have a broad range of observed effects synonymous with the term.

Global warming is the long-term heating of Earth's surface observed since the pre-industrial period (between 1850 and 1900) contributed to by human activities—primarily fossil fuel burning—which increases heat-trapping greenhouse gas levels in Earth's atmosphere.

Efforts to address global warming involve mitigating the emissions of greenhouse gases, transitioning to renewable energy sources, and implementing measures to adapt to the changes that are already occurring.

Since the pre-industrial period, human activities are estimated to have increased Earth's global average temperature by about 1 degree Celsius (1.8 degrees Fahrenheit), a number that is currently increasing by more than 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade. The current warming trend is likely related to human activity since the 1950s and is proceeding at an unprecedented rate over millennia.

"Climate change" and "global warming" are often used interchangeably but have distinct meanings. "Climate change" encompasses a broader range of changes in climate patterns, where global warming specifically focuses on the upward trend in temperatures.

Green initiatives play a crucial role in mitigating global warming by reducing greenhouse gas emissions and promoting sustainability. They aim to address the root causes of climate change and global warming. Green initiatives may seem small, but their collective impact can be significant in addressing the global challenge.

Global Warming vs. Climate Change – REVIEW QUESTIONS

8. **What is the primary difference between global warming and climate change?**
   A. Global warming refers to short-term weather patterns, while climate change refers to long-term weather patterns.
   B. Global warming focuses on the upward trend in Earth's temperatures, while climate change encompasses a broader range of changes in climate patterns.
   C. Climate change is caused by human activities, while global warming occurs naturally.
   D. Climate change only affects local climates, while global warming affects the entire planet.

9. **Since the pre-industrial period, how much has Earth's global average temperature increased due to human activities?**
   A. About 0.5 degrees Celsius (0.9 degrees Fahrenheit)
   B. About 1 degree Celsius (1.8 degrees Fahrenheit)
   C. About 2 degrees Celsius (3.6 degrees Fahrenheit)
   D. About 3 degrees Celsius (5.4 degrees Fahrenheit)

SEER RATINGS

Let's look now at what we can do as general contractors to help fight global warming, climate change, and reduce our carbon footprint. While there are many areas within the job of a general contractor, this course will focus specifically on energy efficiency.

In this section of the course, we are going to examine energy-efficient heating and cooling systems. Included in this section will be an overview of SEER ratings, and Energy Star Program as well as HSPF or heating seasonal performance factors. We will also look at the following heating and cooling systems and smart thermostats, air-source heat pumps, central air conditioning, ductless heating and cooling systems, and geothermal heat pumps. We will discuss the pros and cons of each type of system.

Let's delve into SEER ratings and find out the buzz about them. This section will discuss HSPF ratings, which is an acronym that stands for Heating Seasonal Performance Factor. SEER and SEER2 ratings apply to heat pumps and air conditioning units, while HSPF ratings apply to heating systems. This section will talk primarily about SEER ratings and then launch into a review of select energy-efficient heating systems.

The term SEER rating is an acronym for seasonal energy efficiency ratio which is a measure of the energy efficiency of air conditioning systems and heat pumps this rating measures how efficiently systems can cool a given space over an entire cooling season. It is measured in BTUs which takes into consideration variations of temperature and load.

Although the calculation of a SEER rating can be rather complex, it is simply determined by dividing cooling output in BTUs over a cooling season by the total energy input in watt hours during the same period of time. The higher the rating the more energy-efficient the system is at converting energy (electricity) into cooling. Seer ratings have a range between 13 to 25 and sometimes even higher. The minimum rating is determined by the US Department of energy and it varies by region depending on the climate.

Higher seer ratings are an indicator that systems are more energy efficient meaning that they require less energy to provide the same amount cooling, this translates to lower energy bills over time. It is important to note, however, that higher seer rated systems normally cost more up front. It should also be noted that high seer rated systems have a smaller carbon footprint because they consume less electricity which means they emit less greenhouse gas and therefore are more environmentally friendly.

When considering which type of system you may want to install, you should consider the overall cost and weigh the cost savings experienced by energy efficiency against the upfront cost and an estimate of the purchaser's anticipated duration of occupancy or homeownership. You should also consider where the equipment will be installed geographically because the ideal rating may depend on the local climate for instance, if you are in a hot and humid climate a unit with a higher seer rating may be advisable, but on the contrary in mild climate areas a lower seer rating may suffice. The type of unit you may install may be dictated by the state or jurisdiction wherein it is located.

The main difference between SEER and SEER2 is the testing conditions for each rating system. These differences may seem minimal, but they still produce different data values and warrant a new rating system that aligns more closely with ongoing efforts to reduce overall energy consumption in the United States.

HSPF (Heating Seasonal Performance Factor) ratings measure the efficiency of your heating system and its ability to heat your home comfortably. HSPF2 is the newest type of rating system that expands on the basic HSPF scale. Originally, HSPF ratings were calculated simply using the total heat output during the cold season and dividing that by the energy it took to generate that output. The new HSPF2 ratings started in 2023 use harsher testing conditions to generate the final rating numbers. By upping the external static pressure, all HSPF2 ratings will be lower than comparably efficient units rated using HSPF testing. Numbers drop roughly 10%-15% under the new testing method, which increases the external static pressure by a factor of five. This means that a unit rated a 10 on the HSPF scale will have a rating of 8.5 under the new HSPF2 scale. Despite the lower ratings, all HSPF2 heat pumps are more efficient than HSPF systems.

In summary, when considering the type of equipment you are going to install you should consider the following: the specific needs of the home and the client, the climate in the geographic area where the equipment will be installed, your budget and the customer's budget, and the long-term energy savings. It's critical as general contractors that we consult a licensed mechanical contractor to help us select the most suitable unit for our projects.

SEER Ratings – REVIEW QUESTIONS

10. **What does SEER stand for?**
    A. Seasonal Energy Efficiency Ratio
    B. Seasonal Energy Emission Rating
    C. Sustainable Energy Efficiency Rating
    D. Seasonal Energy Equipment Ratio

11. **How is a SEER rating calculated?**
    A. By dividing the total energy input in watt-hours by the cooling output in BTUs over a cooling season
    B. By measuring the total heat output during the cold season
    C. By dividing the cooling output in BTUs over a cooling season by the total energy input in watt-hours during the same period
    D. By comparing the energy efficiency of different heating systems

12. **What is the primary difference between SEER and SEER2 ratings?**
    A. SEER2 ratings apply only to heating systems, while SEER ratings apply to cooling systems
    B. SEER ratings are more accurate than SEER2 ratings
    C. SEER2 ratings are only used in mild climates
    D. SEER2 ratings use harsher testing conditions compared to SEER ratings

13. **Why are higher SEER-rated systems considered more environmentally friendly?**
    A. They use renewable energy sources
    B. They consume less electricity, resulting in lower greenhouse gas emissions
    C. They are made from recycled materials
    D. They require less maintenance over time

14. **What factors should general contractors consider when selecting heating or cooling systems?**
    A. The specific needs of the home and client
    B. The climate in the geographic area
    C. The budget and long-term energy savings
    D. All of the above

ENERGY STAR PROGRAM

Now that we understand the benefits of green initiative and the importance of lowering our carbon footprints let's look at some of the financial incentives that are available for builders and home buyers to meet some of the new standards. The best and most attractive program is the Energy Star program.

The Energy Star program is where the builder or homeowner meets or exceeds the guidelines established by the Energy Star program. The Energy Star program is a joint initiative of the US Environmental Protection Agency (EPA) and the Department of Energy.

Homes that are to be built according to the standards of the energy Star program are homes that are designed and built with a focus on reducing energy consumption, reducing greenhouse gas emissions, reducing utility costs, and providing the occupants with a comfortable living environment.

In order to ensure that energy star homes are energy-efficient, they must include items such as superior insulation, high-efficiency heating and cooling, energy-efficient systems lighting, appliances, and maintain that focus of reducing energy consumption and lowering utility bills.

Energy Star homes also are intent on improving indoor air quality by ensuring that the building envelope itself is sealed and well insulated and that drafts that can lead to unnecessary infiltration and exfiltration are prevented. Of course, reducing infiltration will reduce the risk of introducing outdoor pollutants into the structure. Many of the Energy Star homes also include ventilation systems that introduce fresh air or incorporate heat recovery systems.

Another focus of energy star homes and the Energy Star program is to reduce greenhouse gas emissions by utilizing where possible renewable energy sources such as solar. The goal is to produce fewer greenhouse gases than conventional homes, which will help combat climate change and reduce the overall carbon footprint for the homeowners.

The Energy Star program also has a focus on occupant comfort by maintaining consistent indoor air temperatures, reducing drafts, minimizing temperature fluctuations, all of which will result in a more comfortable living environment year-round. As builders and as homeowners, you might be asking the question, what's in it for us? Let's take a look.

Builders:
Tax credits are available for builders who build Energy Star certified structures. See IRS Form 8908 for more information.

Under the new Inflation Reduction Act, there is up to $5000 for homes constructed from 2023 to 2032.

Homeowners:
There are also some monetary benefits for homeowners in complying with the Energy Star requirements that are available under the Inflation Reduction Act that was put into place in 2022. There are a broad range of tax credits available to homeowners including heat pumps, air conditioning units, boilers, furnaces which includes oil, gas and propane fueled furnaces as well as biomass fuel stoves. See IRS Form 5695 for more information.

For homes to qualify under the full Energy Star Certification Program, there is an Energy Star checklist. The Energy Star Homes National Field Rater Checklist is a comprehensive guide used by field raters to assess and verify the energy performance of homes seeking Energy Star certification. The checklist covers various aspects related to energy efficiency and sustainability in residential buildings. It includes criteria such as insulation, air sealing, HVAC systems, lighting, and appliances. The goal is to ensure that homes meet specific energy efficiency standards set by Energy Star. Field raters use this checklist to evaluate and document the home's compliance with these standards, contributing to the overall goal of promoting energy-efficient and environmentally friendly residential construction.

Energy Star Program – REVIEW QUESTIONS

15. **What is the primary goal of the Energy Star program?**
    A. To reduce energy consumption, greenhouse gas emissions, and utility costs
    B. To promote luxury home designs
    C. To increase the use of fossil fuels in construction
    D. To eliminate the need for insulation in homes

16. **Which of the following is NOT a feature of Energy Star homes?**
    A. Superior insulation and air sealing
    B. High-efficiency heating and cooling systems
    C. Ventilation systems that introduce fresh air
    D. Increased temperature fluctuations for energy savings

17. **What financial incentives are available for builders under the Energy Star program?**
    A. Up to $5,000 in tax credits for homes constructed from 2023 to 2032 under the Inflation Reduction Act
    B. A one-time payment of $10,000 for each Energy Star home built
    C. Free building materials for Energy Star homes
    D. A tax exemption for all construction projects

18. What is the purpose of the Energy Star Homes National Field Rater Checklist?

A. To provide a guide for designing luxury homes

B. To calculate the cost of building materials for Energy Star homes

C. To evaluate and verify the energy performance of homes seeking Energy Star certification

D. To promote the use of fossil fuels in residential construction

ENERGY-SAVING HEATING SYSTEMS

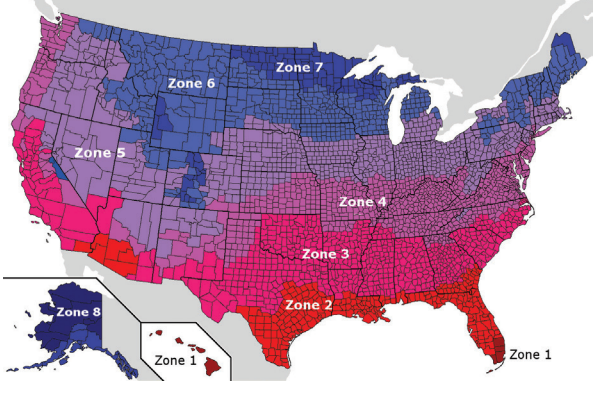
In this section of the course, we will explore the different types of heating systems, and compare the energy efficiency of each.

While furnaces and heat pumps both warm up indoor air, they differ in heating capabilities, energy efficiency, maintenance requirements, use of space, and cost. That's what makes the age-old heat pump versus furnace debate so engaging. Let's take a little deeper look at some of the deciding factors.

The area of the country in which you live is perhaps the biggest factor in your debate. Traditionally, heat pumps are best in areas where winters are mild; think southern and coastal states. Furnaces offer greater ability to heat your home during harsher, colder winter conditions and are therefore better suited in northern locations. Most furnace heating systems in the United States use natural gas for combustion, but propane, oil and electric furnaces are used as well. By selecting a heating system suited to your climate, you can enjoy better comfort and probably lower operating costs as well. Learn the distinction between furnaces and heat pumps, as well as the benefits of electric and gas heating, and the energy efficiency of both options.

To generate heat, furnaces burn oil or gas, while heat pumps run on electricity, drawing heat from outside air—even cold air—and transferring it indoors. Because of how they work, heat pumps produce less heat than furnaces and work best in warmer climates.

Electric heat pumps are more versatile in creating indoor comfort. They provide heat in winter and can also act as air conditioners in summer. This means people in warmer climates can heat and cool their home using just a heat pump system. On the other hand, furnaces only provide heat, so a separate air conditioning unit is required to cool your home in warmer months. While both products have different purposes, some climates allow for a furnace to be installed with a heat pump, known as a dual fuel system for heating and cooling. A dual fuel heating system can offer greater savings. One example would be to pair a gas heater with an air-source heat pump. With two heat sources, the system will gauge the outdoor temperature to determine the most efficient option to heat your home.



In most instances, areas that are in zones 1, 2, and 3 on the map can be well served by heat pumps, and those that are in other zones may be best served by using a furnace for heat and a separate air conditioning unit. Some areas may also be well served by installing a dual fuel system, which we will examine later in the course.

When comparing gas vs. electric heat, the difference in energy efficiency between gas furnaces and heat pump systems is complicated. From a strictly scientific basis, highly efficient heat pumps are technically more energy efficient in that they can transfer more energy than they use. By contrast, some high efficiency natural gas furnaces can provide up to 98.5% efficiency (AFUE). AFUE stands for Annual Fuel Utilization Efficiency.

Here's where it gets complicated. High efficiency heat pumps in warmer climates typically use less source energy on average compared to gas furnaces. In colder climates, 95% efficient gas furnaces fare better than ENERGY STAR® heat pumps. And, due to the relatively lower cost of natural gas versus electricity, lifetime operating costs should be considered as well.

There are several safety considerations when comparing gas versus electric heat. Gas furnaces pose a higher risk of gas explosions and carbon monoxide poisoning compared to electric heat pumps. However, gas furnaces typically have safety features such as automatic shut-off valves and pressure regulators to prevent explosions, while electric heat pumps have safety features such as automatic shut-off switches and refrigerant leak detectors. It is important to have a qualified technician regularly maintain and inspect both types of systems to ensure their safety and efficiency.

Gas furnaces typically have lower upfront costs compared to electric heat pumps, but higher installation costs due to the need for gas lines and ventilation systems. While gas is generally cheaper than the cost of electricity, gas furnaces may have higher lifetime operating costs due to the cost of maintenance and repairs. In contrast, electric heat pumps tend to have higher upfront costs but lower installation costs and can be more efficient in moderate climates, resulting in lower lifetime operating costs.

Both heat pumps and furnaces will last longer and operate more efficiently with preventative maintenance. Both systems include air filters that most homeowners can easily replace. Typical residential heat pump systems include an outdoor unit and an indoor unit that are recommended to be cleaned and inspected annually. A gas furnace does not require an outdoor unit but is often paired with a central air conditioner unit. Your HVAC/mechanical expert can recommend the proper service schedule based on your unique system.

Furnaces typically require at least 30 inches of clearance on all sides and are installed indoors. A heat pump requires only 24 inches of clearance and is installed outdoors. However, a traditional air-source heat pump system also requires an indoor air handler unit called a fan coil.

Ductless Split System

Another option for heating and cooling to consider is a ductless split system heat pump, these units are often referred to as split minis or mini splits. Now we'll discuss some of the advantages and disadvantages of these systems.

Ductless or split mini heat pump systems can be an appropriate solution as add-on units or retrofit systems for use in some smaller spaces. They are excellent for room additions because no ductwork is required, and they can also be a wonderful solution for very efficient new homes where the heating and cooling demand may be less. One of the primary benefits of a split mini system is the fact that no ductwork is required. The systems still have components very similar to a customary heat pump in that a compressor and a condensing unit is needed as well as an air handling unit. The air handling unit is wall-mounted inside the area where heating and air conditioning is required.

There are several advantages as well as some disadvantages to using a ductless-split mini system. Some of the advantages are that they are very good for zone climate conditioning and accordingly they allow you to control each zone individually, meaning that occupied rooms can be conditioned while energy can be saved by not conditioning rooms that may be unoccupied. One benefit is that a split mini condensing unit can be coupled with up to four indoor air handling units. Another primary benefit of ductless systems is that you will not experience the 30% energy loss that can be experienced with ducted systems.

There are a few disadvantages, including that they can have a higher upfront costs. They can also easily be oversized and waste critical energy as well as negatively impact indoor temperatures and humidity control. Also, some customers may feel as though they are intrusive and aesthetically unappealing, and therefore may be opposed to them.

Some additional benefits of ductless split mini system heat pumps are that they are available in various sizes and capacities, they are extremely quiet to operate, and they can have a SEER rating up to 33.1 which is extremely high. These units are Energy Star compliant and therefore can qualify for a tax credit of up to $2000. These are solutions worth exploring for your customers.

Energy-Saving Heating Systems – REVIEW QUESTIONS

19. What is the primary factor in deciding between a heat pump and a furnace?

A. The size of the home
B. The climate of the geographic area
C. The cost of electricity
D. The availability of ductless systems

20. How do heat pumps generate heat?

A. By burning oil or gas
B. By drawing heat from outside air and transferring it indoors
C. By using solar panels to generate heat
D. By converting water into steam

21. What is a dual fuel heating system?

A. A system that uses both gas and oil for heating
B. A system that uses solar and wind energy for heating
C. A system that alternates between electric and propane heating
D. A system that combines a gas heater with an air-source heat pump

22. What does AFUE stand for?

A. Annual Fuel Utilization Efficiency
B. Air Flow Utilization Efficiency
C. Advanced Furnace Utility Efficiency
D. Annual Furnace Usage Efficiency

23. What is one safety consideration of gas furnaces compared to electric heat pumps?

A. Gas furnaces pose a higher risk of carbon monoxide poisoning
B. Electric heat pumps are more prone to refrigerant leaks
C. Gas furnaces require more frequent filter replacements
D. Electric heat pumps are more likely to overheat

24. What is a key advantage of ductless split mini systems?

A. They require no outdoor unit
B. They eliminate the need for air filters
C. They allow for individual zone climate control
D. They are louder than traditional systems

25. What is one disadvantage of ductless split mini systems?

A. They cannot be used in new homes
B. They are prone to high energy loss
C. They can have higher upfront costs and may be aesthetically unappealing
D. They are not Energy Star compliant

26. What is the maximum SEER rating for ductless split mini systems?

A. 25.5
B. 30.2
C. 33.1
D. 35.0

GEOTHERMAL HEAT PUMPS

Next, we'll discuss another energy-efficient option which we seldom consider, but one which could provide a huge benefit not only to your clients but also to the environment. This option is a geothermal heat pump.

Geothermal heat pumps can also be referred to by several different names: geo-exchange systems, earth coupled heating and cooling systems, ground source heat pumps, or water source heat pumps. This technology is not new--it's been in existence since the late 1940s.

Although many parts of the country experience seasonal temperature extremes -- from scorching heat in the summer to sub-zero cold in the winter—a few feet below the earth's surface the ground remains at a relatively constant temperature. Depending on latitude, ground temperatures range from 45°F (7°C) to 75°F (21°C). Like a cave, this ground temperature is warmer than the air above it during the winter and cooler than the air in the summer.

The GHP takes advantage of these more favorable temperatures to become highly efficient by exchanging heat with the earth through a ground heat exchanger.

As with any heat pump, geothermal and water-source heat pumps are able to heat, cool, and, if so equipped, supply the house with hot water. Some models of geothermal systems are available with two-speed compressors and variable fans for more comfort and energy savings. Compared to air-source heat pumps, they are quieter, last longer, need little maintenance, and do not depend on the temperature of the outside air.

A dual-source heat pump combines an air-source heat pump with a geothermal heat pump. These appliances combine the best of both systems. Dual-source heat pumps have higher efficiency ratings than air-source units, but are not nearly as efficient as geothermal units. The main advantage of dual-source systems is that they cost much less to install than a single geothermal unit, and work almost as well.

Even though the installation price of a geothermal system can be several times that of an air-source system of the same heating and cooling capacity, the additional costs may be returned in energy savings in 5 to 10 years, depending on the cost of energy and available incentives in your area. System life is estimated at up to 24 years for the inside components and 50+ years for the ground loop. There are approximately 50,000 geothermal heat pumps installed in the United States each year. For more information, visit the International Ground Source Heat Pump Association.

Geothermal heat pumps work very similarly to conventional heat pumps. The technology involves heat exchange, heat absorption, heat transfer and then distribution. The heat exchange and the heat absorption, however, occur largely in exchange between air and coils or wells embedded in the ground.

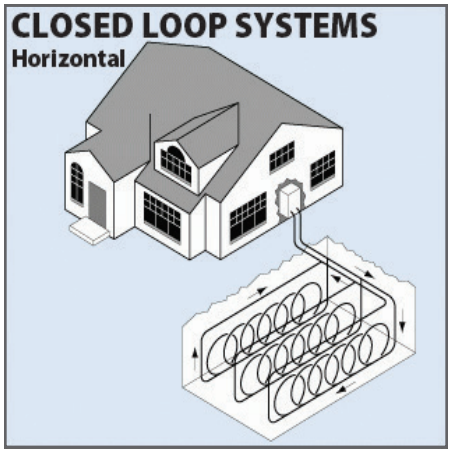
There are different types of geothermal systems the two categories are closed-loop systems which would involve coils installed in a horizontal system, vertical system, or in the body of a pond or lake. There are also open-loop systems which would accomplish the exchange largely in deep wells.

Closed-Loop Systems

Most closed-loop geothermal heat pumps circulate an antifreeze solution through a closed loop, usually made of a high-density plastic-type tubing that is buried in the ground or submerged in water. A heat exchanger transfers heat between the refrigerant in the heat pump and the antifreeze solution in the closed loop.

One type of closed-loop system, called direct exchange, does not use a heat exchanger and instead pumps the refrigerant through copper tubing that is buried in the ground in a horizontal or vertical configuration. Direct exchange systems require a larger compressor and work best in moist soils (sometimes requiring additional irrigation to keep the soil moist), but you should avoid installing in soils corrosive to the copper tubing. Because these systems circulate refrigerant through the ground, local environmental regulations may prohibit their use in some locations.

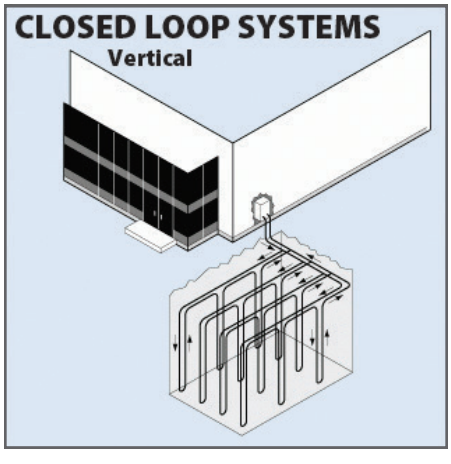
Horizontal



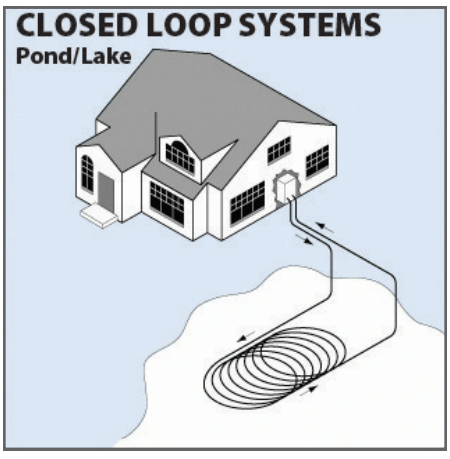
This type of installation is generally most cost-effective for residential installations, particularly for new construction where sufficient land is available. It requires trenches at least four feet deep. The most common layouts either use two pipes, one buried at six feet, and the other at four feet, or two pipes placed side-by-side at five feet in the ground in a two-foot-wide trench. The Slinky™ method of looping pipe allows more pipe in a shorter trench, which cuts down on installation costs and makes horizontal installation possible in areas it would not be with conventional horizontal applications.

Vertical

Large commercial buildings and schools often use vertical systems because the land area required for horizontal loops would be prohibitive. Vertical loops are also used where the soil is too shallow for trenching, and they minimize the disturbance to existing landscaping. For a vertical system, holes (approximately four inches in diameter) are drilled about 20 feet apart and 100 to 400 feet deep. Two pipes, connected at the bottom with a U-bend to form a loop, are inserted into the hole and grouted to improve performance. The vertical loops are connected with horizontal pipe (i.e., manifold), placed in trenches, and connected to the heat pump in the building.



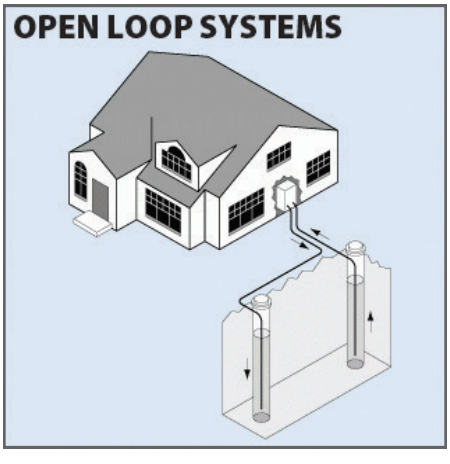
Pond/Lake



If the site has an adequate body of water, this may be the lowest cost option. A supply line pipe is run underground from the building to the water and coiled into circles at least eight feet under the surface to prevent freezing. The coils should only be placed in a water source that meets minimum volume, depth, and quality requirements.

Open-Loop System

This type of system uses well or surface body water as the heat exchange fluid that circulates directly through the Geothermal Heat Pump system. Once it has circulated through the system, the water returns to the ground through the well, a recharge well, or surface discharge. This option is obviously practical only where there is an adequate supply of relatively clean water, and all local codes and regulations regarding groundwater discharge are met.



Geothermal Heat Pumps – REVIEW QUESTIONS

27. What is another name for a geothermal heat pump?

A. Air-source heat pump
B. Ground source heat pump
C. Dual-source heat pump
D. Solar heat pump

28. How does a geothermal heat pump work?

A. By burning fossil fuels to generate heat
B. By exchanging heat with the earth through a ground heat exchanger
C. By using solar panels to absorb heat
D. By drawing heat from the air above ground

29. What is the main advantage of a dual-source heat pump compared to a geothermal heat pump?

A. It is more energy-efficient than a geothermal heat pump
B. It costs much less to install than a geothermal heat pump
C. It requires no maintenance
D. It does not depend on the temperature of the outside air

30. What is the estimated lifespan of the ground loop in a geothermal heat pump system?

A. 10-15 years
B. 20-30 years
C. 50+ years
D. 100 years

31. What is a key feature of a closed-loop geothermal system?

A. It uses well or surface water as the heat exchange fluid
B. It requires no heat exchanger
C. It circulates an antifreeze solution through high-density plastic tubing
D. It is only installed in vertical configurations

32. What is the Slinky™ method in horizontal closed-loop systems?

A. A method of coiling pipe into circles in a pond or lake
B. A way to place more pipe in a shorter trench to reduce installation costs
C. A technique for drilling vertical holes for geothermal loops
D. A method of connecting pipes in an open-loop system

33. Why are vertical closed-loop systems often used for commercial buildings?

A. They are less expensive than horizontal systems
B. They do not require drilling
C. They are more energy-efficient than horizontal systems
D. They require less land area and minimize landscaping disturbance

34. What is a requirement for using a pond/lake closed-loop system?

A. The water source must meet minimum volume, depth, and quality requirements

B. The water must be heated to a specific temperature

C. The system must use copper tubing for heat exchange

D. The water source must be located at least 100 feet from the building

35. What is a key characteristic of an open-loop geothermal system?

A. It uses antifreeze solution in a closed loop

B. It circulates well or surface water directly through the system

C. It requires no compliance with local groundwater regulations

D. It is only suitable for residential installations

SMART THERMOSTATS

Now that we've talked about the various types of heating and cooling systems let's take a quick look at smart thermostats. The question is often asked if smart thermostats actually help save money on heating and cooling costs, so let's explore some of the benefits.

Energy Efficiency: Smart thermostats are designed to optimize energy usage by learning your heating and cooling preferences. These thermostats can adjust the temperature according to your schedule which prevents unnecessary heating and cooling when you're away or during the night. By reducing the constant running of HVAC systems, they can indeed reduce energy consumption.

Remote Access: Many smart thermostat vendors incorporate apps that allow for remote access via smart phone or computer. These features enable you to adjust temperatures even when you're away from home. For instance, if you are coming back from out of town earlier than expected you could adjust the temperature in advance of your arrival, conversely if you left home and forgot to adjust the temperature before leaving you can make the changes remotely to avoid unnecessary heating or cooling costs.

Learning Algorithms: Some smart thermostats have learning algorithms that understand your behavior and can adjust temperature settings accordingly. For instance, if you desire interior temperatures in your home to be 68° when rising, the thermostat may turn the heat on in advance so that the optimum temperature is reached in a timely manner. Over time these thermostats optimize settings based on your routines and preferences which can lead to energy savings.

Usage Reports: Some smart thermostats can provide detailed usage reports on energy usage. These usage reports help you to better understand your heating and cooling patterns and make informed decisions regarding additional energy-saving adjustments that can be made.

Integration With Other Smart Devices: Most smart thermostats have the ability to interface with other smart home devices. Frequently they can be coupled with occupancy sensors and weather forecasts to make more precise adjustments based on real-time data which in turn optimizes energy usage.

The question is often asked: how much money can a smart thermostat can actually save? Some studies and manufacturer claims indicate that potential savings can range from 10 to 23%. However, a recent study by the EPA claims that according to real-world data, smart thermostats that meet Energy Star criteria save users an average of eight percent on their utility bills. Homeowner savings will vary based on the following:

Usage Patterns – Do you run the program or adjust setting frequently?

Energy Efficiency of the Home – Homes with better insulation, energy-efficient windows, and well-maintained HVAC systems might experience more noticeable savings when using a smart thermostat.

Climate – The local climate heavily influences heating and cooling needs. In areas with extreme temperature fluctuations, the savings from a smart thermostat might be more pronounced due to more frequent HVAC system use.

Cost of Energy – The cost of electricity, gas or other energy sources in your area will affect your overall savings. Higher energy costs could mean more significant savings from efficient thermostat use.

Finally, it's important to note that beyond monetary savings, the use of smart thermostats contribute to energy conservation and can positively impact the environment by reducing overall energy consumption.

Smart Thermostats – REVIEW QUESTIONS

36. How do smart thermostats optimize energy usage?

A. By learning your heating and cooling preferences and adjusting temperatures accordingly

B. By running HVAC systems constantly

C. By turning off HVAC systems during the day

D. By requiring manual adjustments for every temperature change

37. What feature of smart thermostats allows users to adjust temperatures while away from home?

A. Learning algorithms

B. Usage reports

C. Remote access via smartphone or computer apps

D. Integration with other smart devices

38. According to the EPA, how much can smart thermostats that meet Energy Star criteria save users on average?

A. 5%

B. 8%

C. 15%

D. 23%

39. **Which of the following factors does NOT influence the savings from a smart thermostat?**

A. Usage patterns

B. Energy efficiency of the home

C. The brand of the thermostat

D. The local climate

ENERGY SAVING WATER HEATER SYSTEMS

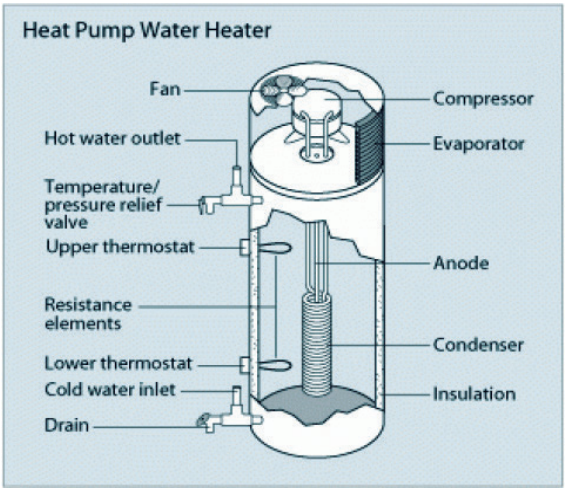
In this section of the course, we will consider different types of water heating systems and compare their energy efficiency. As you begin this section, it's important to note approximately how much energy in a United States household is consumed by water heating. As you can see from the attached pie chart, water heating consumes approximately 18% of a home's total energy consumption.

According to the Department of Energy, average American households spend between $400 and $600 a year on electric water heating alone. This amount can vary based on electricity rates in your area and the water heater's efficiency. The amount of energy an electric water heater uses depends on several factors, including: the age of the unit, the size of the unit, the type of electric water heater, the set temperature, and the amount of water used by the household each day. There are two basic types of electric water heaters: storage water heaters and tankless water heaters. Storage water heaters lose heat energy because water is heated even when it isn't being used, so you are paying for energy that is being wasted. Tankless water heaters on the other hand cost more to purchase and install, however, according to the Department of Energy they are between 4% and 34% more energy-efficient than storage water heaters depending on the amount of water that's being used. Switching to a tankless electric water heater can potentially save homeowners $100 or more per year.

In comparison, natural gas water heaters normally cost between $285 and $425 per year. Natural gas operating costs, in most instances, are often cheaper than electric by approximately 28.5%, however, for an exact comparison you should check your local electric and gas rates. Like electric water heaters, the actual usage can vary based on capacity, efficiency of the unit, whether it is a storage type unit or a tankless unit, the set temperature, and the amount of water that is used inside the home. We will explore tankless water heaters further in the latter part of this section.

During this section of the course we will explore heat pump water heaters, high-efficiency gas water heaters, solar water heaters, geothermal water heaters, and tankless water heaters, and we will also discuss the advantages and disadvantages of each.

Let's start out with a type of water heater that appears to be gaining in acceptance. Heat pump water heaters work very similarly to heat pump HVAC systems where they absorb heat and release heat. Like their HVAC counterpart, heat pump water heaters draw ambient air from their surroundings which might be a basement, garage or out-of-doors. The heat is then transferred and absorbed into the water in the storage tank, and then the entire process begins again. There are also traditional electric resistance elements located in the heat pump water heater to provide supplemental heating during higher demand levels or when the heat exchange is inadequate.



Heat pump water heaters work very similarly to HVAC heat pumps in that a compressor takes a low-pressure gas and compresses it to increase the temperature. That heat is then transferred and released in a coil into the water that is located in the storage tank. An additional benefit of heat pump water heaters is they can also serve as a dehumidifier and are often the water heater of choice if they are going to be installed in a basement where humidity can be an issue. Like HVAC heat pumps, heat pump water heaters work best in mild climates where in colder climates the electric heating elements may be employed more.

The benefits of heat pump water heaters are as follows: they produce the same amount of hot water with less electricity because they transfer heat from air. It's estimated by the Department of Energy that they can save 50 to 60% on a household's water heating costs. Because of the savings, heat pump water heaters are considered more environmentally friendly. There are also tax incentives and rebates that are associated with heat pump water heaters, some of which we covered in an earlier section of this course but are also mentioned in the next section. It's important to note that the initial cost of installing a heat pump water heater can be considerably more, but the long-term savings can really accumulate over the 10-to-15-year lifespan of the unit.

Savings and Paybacks for ENERGY STAR Heat Pump Water Heaters				
Household Size	Annual kWh Savings	Annual $ Savings	Payback (Years)	Lifetime Savings
2	1,880	$270	5.5	$2,050
3	2,820	$410	3.7	$3,830
4	3,760	$550	2.7	$5,610
Assumes: $ .146 cents/kWh; Incremental Cost = $1,503 ; 13-year lifespan				

Energy Star certified HPWHs can save a household of 4 approximately $550 per year on electric bills compared to a standard electric water heater, and more than $5,610 over the HPWH's lifetime.

A smart investment: While a certified HPWH costs more upfront, the savings will pay back the difference in about three years for a household of 4. Replace your aging electric water heater before it fails, and start enjoying the savings right away.

A purchase that protects the environment: If all electric water heaters sold in the United States were Energy Star certified HPWHs, the energy cost savings would grow to about $8 billion each year, and approximately 150 billion pounds of annual greenhouse gas emissions would be prevented, equivalent to the emissions from more than 14 million vehicles.

When comparing an electric water heater to heat pump water heater, it's important to look at the various associated benefits. For instance, an electric water heater has no tax credit for initial installations while a heat pump water heater can provide a tax credit of up to $2000. Electric water heaters can provide enough hot water for a single shower that lasts 27 minutes, while a heat pump water heater could potentially provide enough hot water for a single shower to last 51 minutes. Heat pump water heaters provide enough hot water to have nearly twice as many back-to-back showers, more simultaneous showers, accommodate larger tubs, have significantly lower annual operating costs, have a much higher uniform energy factor (UEF), and customarily have a ten-year warranty as compared to a six-year warranty. It's also important to note that many utility companies offer additional rebates, which are worth researching.

High Efficiency Gas Storage Water Heaters

Now we'll examine more traditional water heater: the natural gas storage water heater. However, we will concentrate on some high-efficiency units that are now available on the market.

High-efficiency gas storage water heaters employ the same basic technology as gas storage water heaters where there is a glass lined steel tank and a burner located at the bottom. However, these units have better insulation surrounding the tank, more efficient burners and because of this, use approximately 8% less energy. Some of the units also gain extra efficiency because they employ a secondary heat exchanger which traps extra heat in the unit transferring it back to the stored water. The high-efficiency models are built with helical internal heat exchangers that keep hot combustion gasses in the tank longer to transfer more heat into the water, increasing efficiency and reducing operating costs. These models generally have higher BTU/H inputs, which means the heater can deliver more hot water.

Something that all of us should note is that the Department of Energy has proposed new energy efficiency standards for water heaters which are estimated to save Americans more than $11 billion a year on utility bills. This could dictate many required changes for contractors in the future. It's recommended that you research current standards in your area at the time of completing this course.

Geothermal Water Heaters

We previously discussed geothermal heat pumps, so the concept should not be new to us. Although geothermal water heaters can be standalone they are usually installed as part of a combination heat pump and water heater solution, geothermal water heaters use a process or device called a "desuperheater" which carries excessive heat from the compressor and deposits it in the water therefore the water heater storage tank already contains warm water and therefore only a small amount of supplemental heating is needed.

Just how much can you expect to save on your electricity bill? Let's look at the following example to get some real-world numbers.

According to the U.S. Energy Information Administration, domestic hot water heating makes up approximately 17.7% of your home's electricity consumption. So, if you spend on average $350 per month on your electricity bill, here's how much of that is due to domestic hot water use:

$350 x 17.7% = $61.95/month

$61.95 x 12 months = $743.40/year

If you install a geothermal heat pump, you could save between 50 and 60% on your domestic hot water costs. Let's split the difference and estimate a 55% savings rate. That means you'll save:

$61.95 x 55% = $34.07/month

$34.07 x 12 months = $408.87/year

Tankless Water Heaters

Tankless water heaters are certainly trending in modern times, so let's take a look at some of the advantages and disadvantages of utilizing them. Tankless water heaters are often referred to as on demand water heaters or instantaneous water heaters.

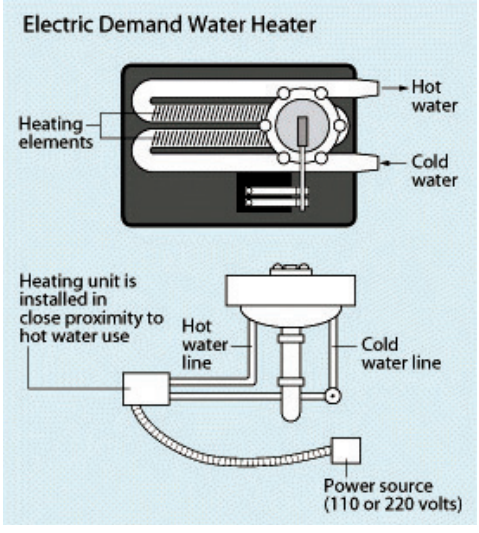
Tankless water heaters heat water instantaneously without the use of a storage tank. When a hot water faucet is turned on, cold water flows through a heat exchanger in the unit, and either a natural gas burner or an electric element heats the water.

As a result, tankless water heaters deliver a constant supply of hot water. You don't need to wait for a storage tank to fill up with enough hot water. However, a tankless water heater's output limits the flow rate.

Typically, tankless water heaters provide hot water at a rate of 2–5 gallons per minute. Gas-fired tankless water heaters produce higher flow rates than electric ones.

Sometimes, however, even the largest, gas-fired model cannot supply enough hot water for simultaneous, multiple uses in large households. For example, taking a shower and running the dishwasher at the same time can stretch a tankless water heater to its limit.

To overcome this problem, you can install two or more tankless water heaters. You can also install separate tankless water heaters for appliances—such as a clothes washer or dishwater—that use a lot of hot water in your home. However, additional water heaters will cost more and may not be worth the additional cost.



Let's take a quick look at using tankless water heaters and what some of the advantages might be. Homes that use an average of 41 gallons of water or less per day can achieve approximately 24 to 34% more energy efficiency. High usage homes (those using more than 86 gallons a day) will still experience an 8 to 14% gain in energy efficiency. Tankless water heaters also are believed to last longer in that they have an estimated life expectancy of 20 years. They are also believed to be easier to maintain in that they have easily replaceable parts when needed. One of the biggest *advantages* of tankless water heaters is that there is no standby heat loss. This means hot water that would be stored in a tank does not suffer from the associated cooling and reheating.

The *disadvantages* are tankless water heaters cost more and may not provide adequate hot water to meet periods of peak demand. In many larger homes more than one unit may be required to accommodate those demand requirements.

Solar Water Heaters

Solar water heaters or what is often referred to as solar domestic hot water systems can be a cost-effective way to generate hot water in a home. Solar domestic hot water systems have two primary advantages: first, they can be used in any climate, and second, the fuel that they use has zero cost.

There are two types of solar domestic water heater systems: direct circulation systems and indirect circulation systems. Direct circulation systems circulate the water through the collectors and into the home these units cannot be used in locations where freezing is an issue. Indirect systems are somewhat more complex in that they use a heat transfer liquid such as antifreeze and therefore must use a heat exchanger in the storage tank. These systems are used primarily in locations where freezing temperatures are present.

Active and passive systems are often installed as pre-heaters to existing hot water systems. According to the U.S. Depart of Energy, "Solar water heating systems almost always require a backup system for cloudy days and times of increased demand. Conventional storage water heaters usually provide backup and may already be part of the solar system package. A backup system may also be part of the solar collector, such as rooftop tanks with thermosyphon systems. Since an integral-collector storage system already stores hot water in addition to collecting solar heat, it may be packaged with a tankless or on demand type water heater for backup."

In determining whether a solar domestic hot water system is right for you or your customers, you must understand that solar collectors themselves do not meet Energy Star requirements. Therefore, these systems must have a backup water heater, and be rated by the Solar Rating and Certification Corporation. As part of your analysis, you should estimate the cost and efficiency gains that you may realize from the proposed system and compare that to the current water heating usage cost. You should also consider your geographic location and the amount of available sunshine to be used as a fuel source. You should then calculate your overall payback to determine if it is beneficial. According to the U.S. Department of Energy, their estimate is that you can save approximately 50 to 80% in your water heating costs with a solar water heating system.

Energy Saving Water Heater Systems – REVIEW QUESTIONS

40. According to the course, what percentage of a U.S. household's total energy consumption is used for water heating?

A. 10%
B. 18%
C. 25%
D. 30%

41. How much can tankless water heaters save in energy efficiency compared to storage water heaters?

A. 4% to 34%
B. 10% to 20%
C. 15% to 25%
D. 30% to 50%

42. What is a key benefit of heat pump water heaters?

A. They use natural gas for heating
B. They can serve as a dehumidifier
C. They require no electricity to operate
D. They are only suitable for outdoor use

43. How much can Energy Star certified heat pump water heaters save a household of 4 annually on electric bills?

A. $200
B. $350
C. $550
D. $750

44. What is the estimated lifespan of a heat pump water heater?

A. 5-7 years
B. 10-15 years
C. 20-25 years
D. 30 years

45. What is the primary advantage of tankless water heaters?

A. They provide hot water instantly without standby heat loss
B. They are less expensive to install than storage water heaters
C. They require no maintenance
D. They are ideal for households with low water demand

46. What is a disadvantage of tankless water heaters?

A. They have a shorter lifespan than storage water heaters
B. They may not provide enough hot water during peak demand
C. They are not energy-efficient for small households
D. They require a backup system for cloudy days

47. How much energy efficiency can homes using 41 gallons of water or less per day achieve with tankless water heaters?

A. 10-15%
B. 24-34%
C. 40-50%
D. 60-70%

48. What is a key feature of solar water heaters?

A. They use natural gas as a backup fuel source
B. They can save 50-80% on water heating costs
C. They are Energy Star certified
D. They do not require a backup system

49. What is the purpose of a "desuperheater" in geothermal water heaters?

A. To cool water before it enters the storage tank
B. To eliminate the need for a backup system
C. To transfer excess heat from the compressor to the water
D. To increase the flow rate of hot water

50. What is a disadvantage of solar water heaters?

A. They require a backup system for cloudy days
B. They cannot be used in any climate
C. They are less efficient than traditional water heaters
D. They are not compatible with tankless systems

51. About how much can a geothermal heat pump save annually on domestic hot water costs for a household spending $350/month on electricity?

A. $200
B. $300
C. $400
D. $500

52. What is a key feature of high-efficiency gas storage water heaters?

A. They use electric resistance elements for heating
B. They employ helical internal heat exchangers to increase efficiency
C. They require no insulation around the tank
D. They are less expensive to operate than tankless water heaters

53. What is the estimated energy savings if all electric water heaters sold in the U.S. were Energy Star certified HPWHs?

A. $5 billion annually
B. $8 billion annually
C. $10 billion annually
D. $12 billion annually

54. What is a key advantage of indirect solar water heating systems?

A. They are suitable for locations with freezing temperatures
B. They do not require a heat exchanger
C. They are less expensive than direct systems
D. They do not require a backup system

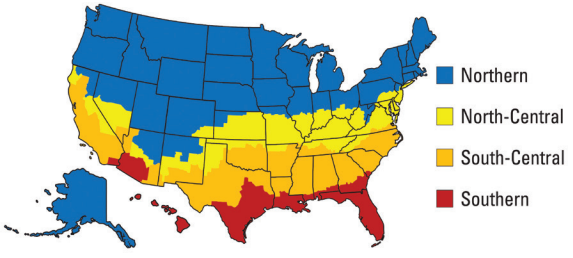
ADDITIONAL ENERGY EFFICIENT ITEMS

As general contractors, many of us build new residential construction; however, some of us specialize in remodeling and renovating existing homes. Others may specialize in building additions to existing homes. In this section we will look at items such as insulation, windows and doors, lighting, appliances, the installation of electric vehicle charging stations, and even consider energy efficient pool and spa pumps.

Insulation

Let's begin by looking at insulation. We will not only look at insulation in existing houses but what today's standards are for Energy Star certification. Let's briefly define what insulation is: Insulation is an important factor that makes your home comfortable and energy efficient. Insulation is also called the unsung hero of the home; you don't see it and rarely think about it. There are plenty of insulation types and all of them are made differently. Some different materials used include spray foam insulation, fiberglass, and foam insulation. Vermiculite and cellulose are older types of insulation which are no longer widely used. Insulation is applied in various ways, such as batting and blowing it in. Adding insulation to a home provides resistance to heat flow and lowers heating and cooling bills. Insulating homes properly not only reduces heating and cooling costs but also improves comfort.

Windows



ENERGY STAR® Certification Criteria for Residential Windows

WINDOWS			
Climate Zone	U-Factor[1]	SHGC[2]	
Northern	≤ 0.22	≥ 0.17	Prescriptive
	= 0.23	≥ 0.35	Equivalent Energy Performance
	= 0.24		
	= 0.25	≥ 0.40	
	= 0.26		
North-Central	≤ 0.25	≤ 0.40	
South-Central	≤ 0.28	≤ 0.23	
Southern	≤ 0.32	≤ 0.23	

Air Leakage ≤ 0.3 cfm/ft²

[1] Btu/h-ft²-°F
[2] Solar Heat Gain Coefficient

ENERGY STAR® Certification Criteria for Residential Skylights

SKYLIGHTS		
Climate Zone	U-Factor[1]	SHGC[2]
Northern	≤ 0.45	Any
North-Central	≤ 0.50	≤ 0.25
South-Central		
Southern		

Air Leakage ≤ 0.3 cfm/ft²

[1] Btu/h-ft²-°F
[2] Solar Heat Gain Coefficient

ENERGY STAR® Certification Criteria for Residential Doors

DOORS			
Glazing Level	Climate Zone	U-Factor[1]	SHGC[2]
Opaque	All Zones	≤ 0.17	No Rating
≤ ½-Lite	All Zones	≤ 0.23	≤ 0.23
> ½-Lite	Northern	≤ 0.26	≤ 0.40
	North-Central		
	South-Central	≤ 0.28	≤ 0.23
	Southern		

Air Leakage for Sliding Doors ≤ 0.3 cfm/ft²
Air Leakage for Swinging Doors ≤ 0.5 cfm/ft²
[1] Btu/h·ft²·°F
[2] Solar Heat Gain Coefficient

Another item we should seriously scrutinize on all new builds or substantial remodels is to ensure that our windows and doors are also energy compliant. Remember the lower the number, the better at blocking heat generated by sunshine. Note: U-factors range from .20 – 1.20, Solar Heat Gain Coefficients range from 0-1, in both cases the lower the number the better.

It's also important to consider the style of window you are installing, for instance a fixed sash window may have the least amount of air leakage around the edges of the glass because the window is not designed to open or close. Other types of windows, for instance casement windows, can be very energy efficient because they create a tight seal when mechanically closed and locked. Other windows such as single hung or double hung windows may allow more air to filter around the edges of the window diminishing their energy efficiency. Naturally, we not only have to consider the energy efficiency of the window but also the aesthetic and architectural desires of the client.

Lighting

As responsible builders, we shouldn't overlook the lighting in structures that we build. In addition to taking advantage of natural lighting, it is important for us to realize that the average household spends about 15% of their electricity budget on lighting. By using LED lights, the average household can save about $225 per year. When buying fixtures or bulbs, be certain to choose bulbs that have earned the Energy Star designation. Do not overlook some other important items such as ceiling fans, light strings used for over counter lighting, and out-of-the-way fixtures and bulbs. Lighting companies now make it a practice to place energy consumption labels on nearly all their products, indicating whether or not the product is Energy Star compliant and what the estimated cost is of using that product.

Energy Star Compliance

When discussing these topics, individuals often ask "What makes a product Energy Star?" Energy Star products are the same or better than standard products, only they use less energy. To earn the Energy Star, they must meet strict energy efficiency criteria as set forth by the U.S. Environmental Protection Agency or the U.S. Department of Energy. Since they use less energy, these products save you money on your electricity bill and help protect the environment by causing fewer harmful emissions from power plants and users get the features and quality expected.

Appliances

When considering building energy efficient structures, it's important that we not overlook appliances. There are a number appliances that are available with the Energy Star certification; among them are air cleaners, clothes washers and dryers, dehumidifiers, dishwashers, electric cooking products such as cooktops and ovens, freezers, and refrigerators.

Some examples of items that have earned the Energy Star would be the following:

- Refrigerators that are at least 50% more efficient than the minimum federal efficiency standard.
- Qualified televisions which consume 3 W or less when switched off compared to a standard TV which consumes almost 6 W on average.
- Office equipment that qualifies automatically enters a low-power sleep mode after a period of inactivity.

Pools

Many homes enjoy a swimming pool or spa. Current statistics state there are over 10.7 million swimming pools and approximately 7.3 million hot tubs in United States. One energy-saving strategy is to install a variable speed pool or spa pump. It is also wise to replace existing single speed pool pumps with variable speed pumps.

According to Duke Energy, older single-phase pumps use approximately 20% of the home's annual energy use, second only to air conditioning that is used in the summer. Variable speed pumps can save a homeowner up to $450 a year in energy costs, and there are potential rebate opportunities of up to $300. This provides a homeowner with an approximately two year payback on the cost of the pump.

Additional Energy Efficient Items – REVIEW QUESTIONS

55. What is the primary benefit of adding insulation to a home?

A. It improves the aesthetic appeal of the home
B. It eliminates the need for air conditioning
C. It reduces heating and cooling costs while improving comfort
D. It increases the resale value of the home

56. Which type of window is likely to have the least air leakage?

A. Single hung window
B. Double hung window
C. Casement window
D. Fixed sash window

57. How much can the average household save annually by using LED lights?

A. $100
B. $150
C. $225
D. $300

58. What is a requirement for a product to earn the Energy Star designation?

A. It must be manufactured in the United States
B. It must meet strict energy efficiency criteria set by the EPA or Department of Energy
C. It must cost less than standard products
D. It must be made from recycled materials

59. What is a key advantage of variable speed pool or spa pumps compared to single-speed pumps?

A. They require no maintenance

B. They can save up to $450 a year in energy costs

C. They are less expensive to purchase

D. They eliminate the need for pool filters

CONCLUSION

In conclusion, global warming and climate change are undeniable realities. As the construction industry stands as the largest consumer of resources and a major contributor to greenhouse gas emissions, it is imperative for general contractors to take responsibility. By prioritizing energy-conscious practices and constructing energy-efficient structures, the industry can play a pivotal role in mitigating its environmental impact. Through innovative solutions and sustainable building methods, contractors have the power to drive meaningful changes and contribute to a healthier, more sustainable future for our planet.

Conclusion – REVIEW QUESTIONS

60. Why is it important for general contractors to prioritize energy-conscious practices?

A. To reduce construction costs

B. To mitigate the construction industry's environmental impact and greenhouse gas emissions

C. To increase the speed of construction projects

D. To eliminate the need for building regulations

Notes

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