ENERGY STAR® Hot Water Systems for High Performance Homes

Welcome to the Webinar! We will start at 11:00 AM Eastern.

There is no call in number.

The audio will be sent through your computer speakers.

All questions will be submitted via typing.

Date: September 30, 2011

Building AMERICA® U.S. Department of Energy

Video of presenters

Building Technologies Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building America Program: Introduction

Building America® U.S. Department of Energy

Background

Building America Program Founded to:

- Reduce Energy Use
- Promote Building Science/System Engineering Approach
- Ensure Quality, Health and Durability
- Accelerate Adoption of High Performance Technologies

Building America® U.S. Department of Energy

BA-PIRC

#1: Solutions that can be Implemented on a Production Basis

- Cost Effective, Least Cost, Highest Value Solutions:
  - Low Risk
  - Reliable
  - Durable
  - Clearly Understood Energy Savings and Performance Benefits

#2: Development of Whole Systems Knowledge

- Clearly Understood Cost/Performance Tradeoffs
- Identification and Resolution of Knowledge Gaps
- Clear Definition of Stakeholder Needs:
  - Contractors
  - Utilities
  - Realtors
  - Financial Institutions
  - Homeowners

#3: Continuous Evaluation and Performance Feedback

- Measures Guidelines
- Measures Database
- Accurate Audit and Analysis Tools
- Well Characterized Test House and Pilot Community Performance Data

15 Industry Research Teams

CARB
Consortium for Advanced Residential Buildings

Alliance for Residential Building Innovation (ARBI)

N.E.L.C.
The National Energy Leadership Corps

IBACOS
Home Quality + Performance

NAHB RESEARCH CENTER

NorthernSTAR Building America Partnership

BIRA
BUILDING INDUSTRY RESEARCH ALLIANCE
...a catalyst for change

Building America Retrofit Alliance (BARA)

bsc Building Science Corporation

Fraunhofer USA

ARIES Collaborative

DOW Building Solutions

Habitat Cost Effective Energy Retrofit Program

PARR
The Partnership for Advanced Residential Retrofit

Building Energy Efficient Homes for America (BeeHa)

BA-PIRC

Downloading the PowerPoint File

- After the presentation you can download the PowerPoint file at the following location:

  www.buildingamerica.gov/meetings.html

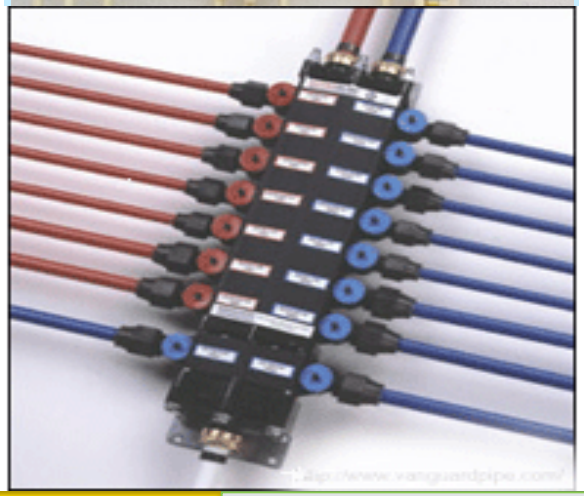
- This link will be shown again at the end of the presentation

Q&A

- Throughout this presentation, you can Submit your questions using the Q&A box on the left of your screen
- All questions will be addressed at the end of the webinar

Building Technologies Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy



Energy Star Hot Water Systems for High Performance Homes

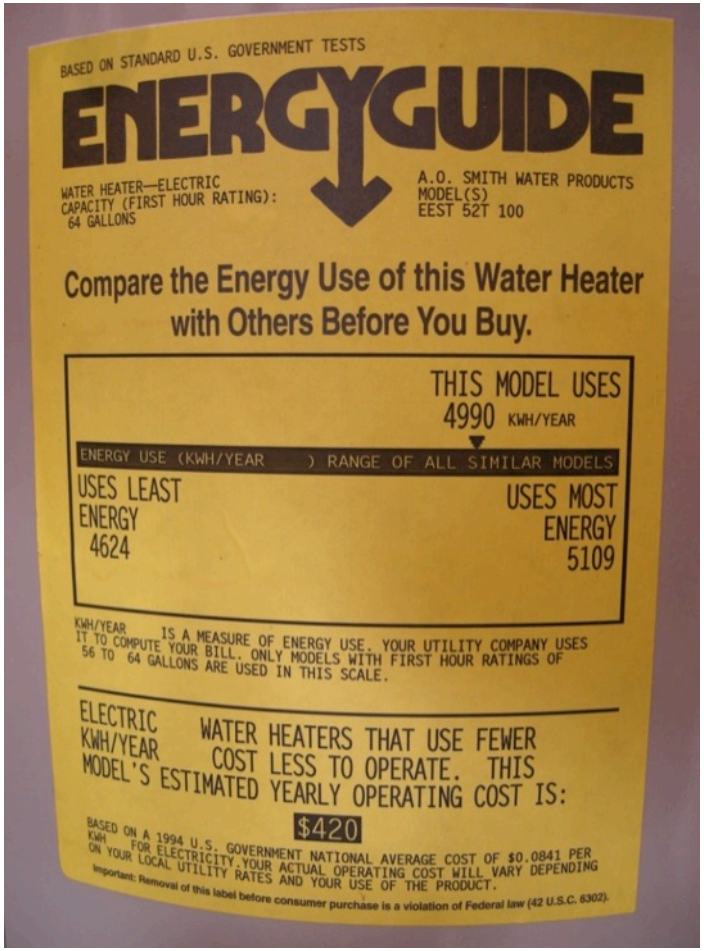
Building AMERICA
U.S. Department of Energy

Objectives

- Overview of Energy Star water heater types
  - Gas
  - Condensing gas
  - Tankless gas
  - Heat pump water heater
  - Solar
- Compare water heater efficiencies
- Design considerations for water heater types
- Optimizing other benefits of water heater types

Challenge of Selecting WH

ENERGYGUIDE Label



BASED ON STANDARD U.S. GOVERNMENT TESTS

ENERGYGUIDE

WATER HEATER—ELECTRIC
CAPACITY (FIRST HOUR RATING):
64 GALLONS

A.O. SMITH WATER PRODUCTS
MODEL(S)
EEST 52T 100

Compare the Energy Use of this Water Heater with Others Before You Buy.

THIS MODEL USES
4990 KWH/YEAR

ENERGY USE (KWH/YEAR) RANGE OF ALL SIMILAR MODELS

USES LEAST ENERGY
4624

USES MOST ENERGY
5109

KWH/YEAR IS A MEASURE OF ENERGY USE. YOUR UTILITY COMPANY USES IT TO COMPUTE YOUR BILL. ONLY MODELS WITH FIRST HOUR RATINGS OF 56 TO 64 GALLONS ARE USED IN THIS SCALE.

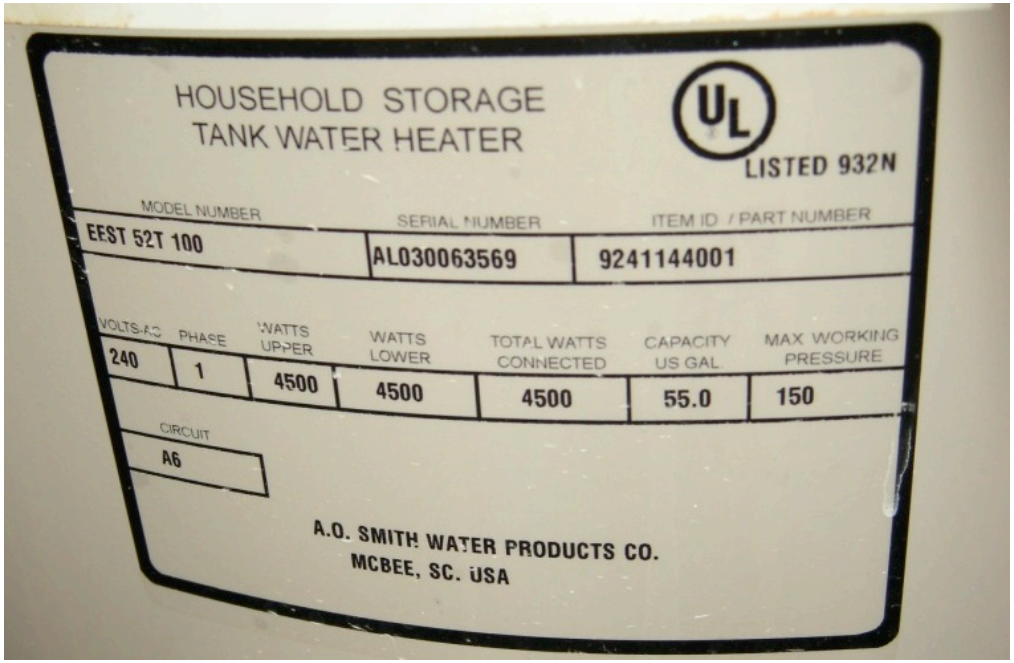
ELECTRIC KWH/YEAR MODEL'S ESTIMATED YEARLY OPERATING COST IS:

WATER HEATERS THAT USE FEWER COST LESS TO OPERATE. THIS

$420

BASED ON A 1994 U.S. GOVERNMENT NATIONAL AVERAGE COST OF $0.0841 PER KWH FOR ELECTRICITY. YOUR ACTUAL OPERATING COST WILL VARY DEPENDING ON YOUR LOCAL UTILITY RATES AND YOUR USE OF THE PRODUCT.

Important: Removal of this label before consumer purchase is a violation of Federal law (42 U.S.C. 6302).



HOUSEHOLD STORAGE TANK WATER HEATER

UL LISTED 932N

MODEL NUMBER	SERIAL NUMBER	ITEM ID / PART NUMBER
EEST 52T 100	AL030063569	9241144001

VOLTS-AC	PHASE	WATTS UPPER	WATTS LOWER	TOTAL WATTS CONNECTED	CAPACITY US GAL	MAX WORKING PRESSURE
240	1	4500	4500	4500	55.0	150

CIRCUIT
A6

A.O. SMITH WATER PRODUCTS CO.
MCBEE, SC. USA

BA-PIRC

Water Heater Types:

- Electric
- High Performance Gas
- Gas Condensing
- Tankless
- Heat Pump Water Heater (HPWH)
- Solar Water Heating

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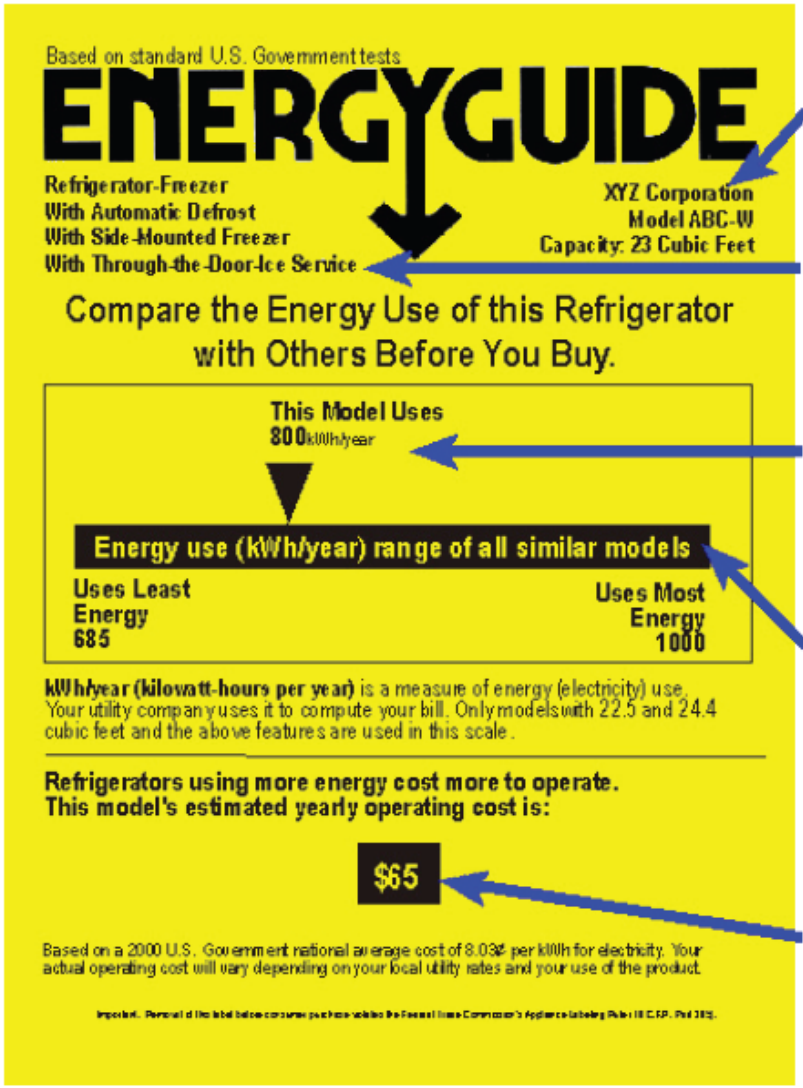
Efficiency: Energy Factor

- EF is a numeric value typically less than 3.0, used to compare performance. Higher numeric values indicate higher efficiency.
- EF is the ratio of useful energy output from a water heater with respect to the energy delivered to the water heater.

No Energy Factor Rating!



Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Side-Mounted Freezer
With Through-the-Door-Ice Service

XYZ Corporation
Model ABC-W
Capacity: 23 Cubic Feet

Compare the Energy Use of this Refrigerator with Others Before You Buy.

This Model Uses
800 kWh/year

Energy use (kWh/year) range of all similar models

Uses Least Energy
685

Uses Most Energy
1000

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 22.5 and 24.4 cubic feet and the above features are used in this scale.

Refrigerators using more energy cost more to operate.
This model's estimated yearly operating cost is:

$65

Based on a 2000 U.S. Government national average cost of 8.03¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase violates the Federal Trade Commission's Appliance Labeling Rule (16 C.F.R. Part 305).

Manufacturer, model number and appliance type.

Information about features, capacity and size, so you can compare models.

Estimates of the appliance's annual energy use. The lower the number, the more energy-efficient the appliance, and the less it costs to run.

The range of ratings for similar models, from "uses least energy" to "uses most energy." This scale shows how a particular model measures up to the competition.

An estimate of the annual cost to run this model.

GAMA Rating

Form **RWHR**

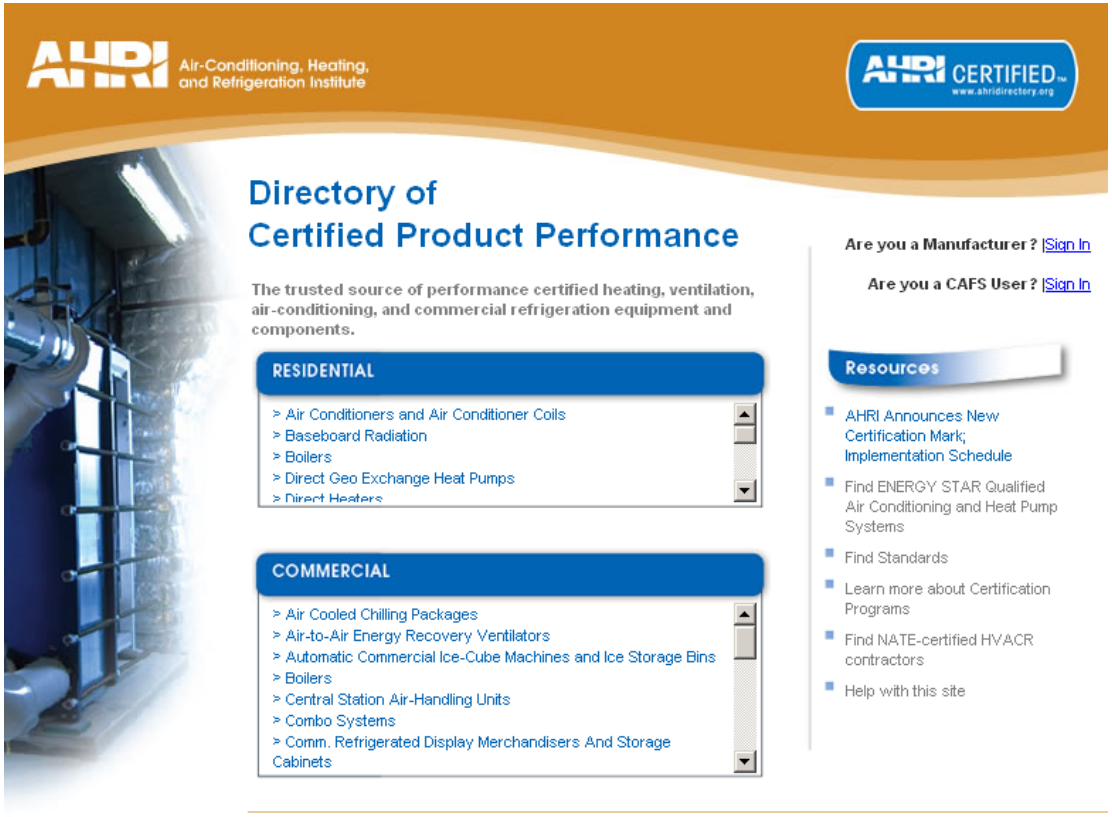
Request for Approval for
Residential Water Heater Rating

version 3/2003
Gas Appliance Manufacturers Association

Name and Address of Company to Appear in Directory:	Model Series Name:	Energy Source:	Type of Water Heater	Earliest Publish Date:
A.O. SMITH WATER PRODUCTS CO. P.O. Box 600 25731 US Hwy 1 McBee , SC 29101-8510 Trade Names: A.O. Smith	PV FVIR	(•) Gas ( ) Oil ( ) Electric Resistance ( ) Heat Pump - with tank ( ) Heat Pump - without tank	storage	8/26/05

Row #	Model #	Standard Footnotes	Custom Footnotes	Type of Gas	1st HR Supply Rating, Gals.	Energy Factor	Storage Volume, Gals.	Input MBTUH or kWh	Recovery Effcy, %	Basic Model
7	GPVR 50* 100	Power Combustion or Power Vent Electronic Ignition (No Standing Pilot)	FVIR Compliant * additional Letters may be placed here to indicate Trim Packages.	Natural	83.0	0.67	50	40.0 MBTUH	82	true

Ratings Directory

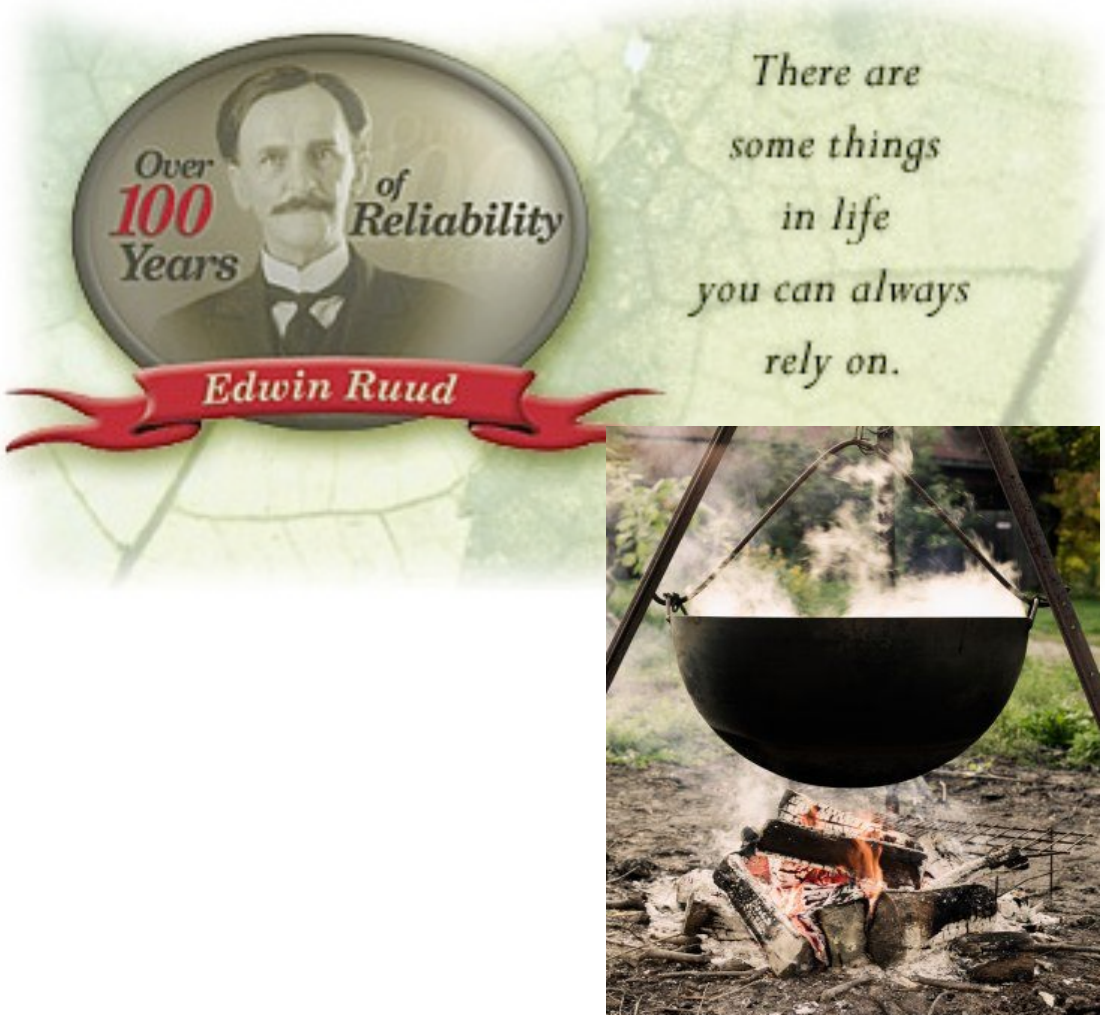


www.ahridirectory.org

EF Example

- EF 1.0 = 100% efficient, no heat losses
- EF Electric – typical 0.92
- EF Gas – typical 0.65

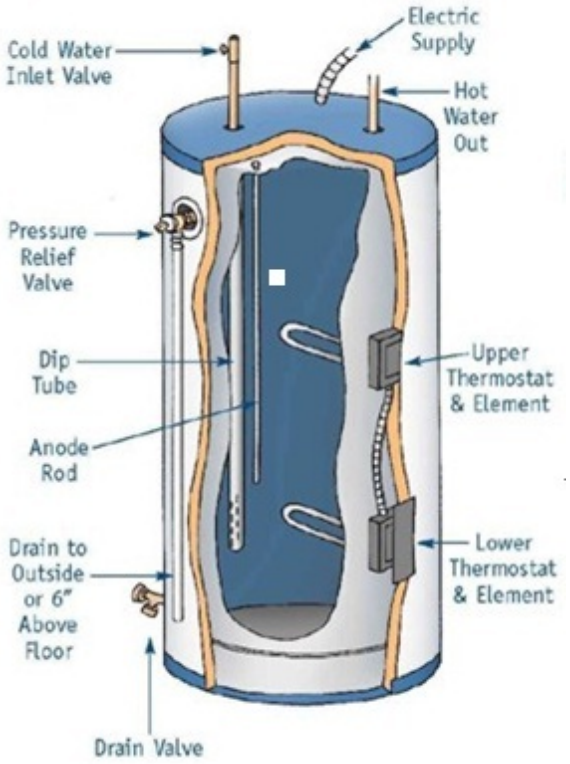
Conventional Electric Water Heater



Conventional Electric Water Heater

Electric Resistance Water Heaters

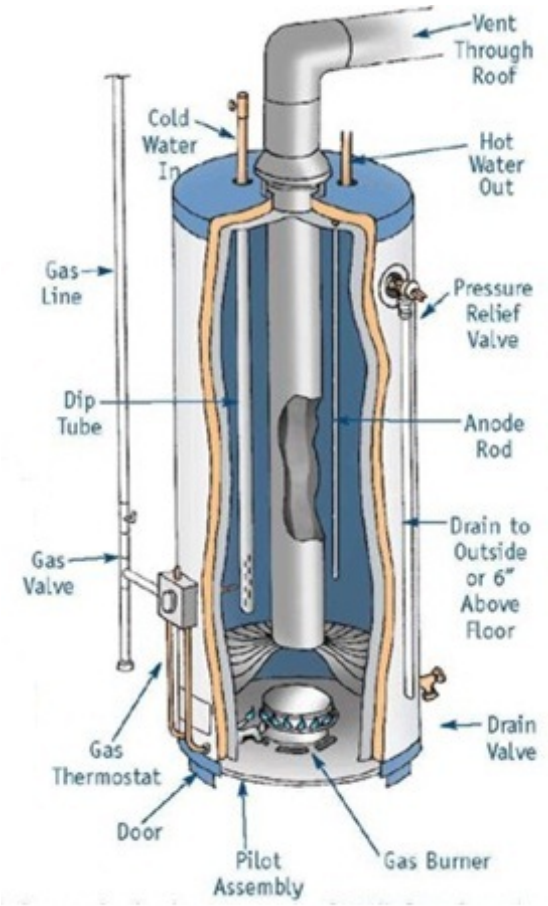
- Electric resistance water heaters are not Energy Star rated



Gas Water Heaters

Key Things to Know

- Energy Star = EF of 0.67
- Initial cost = $500 to $800
- Payback for the Energy Star unit < 3 years

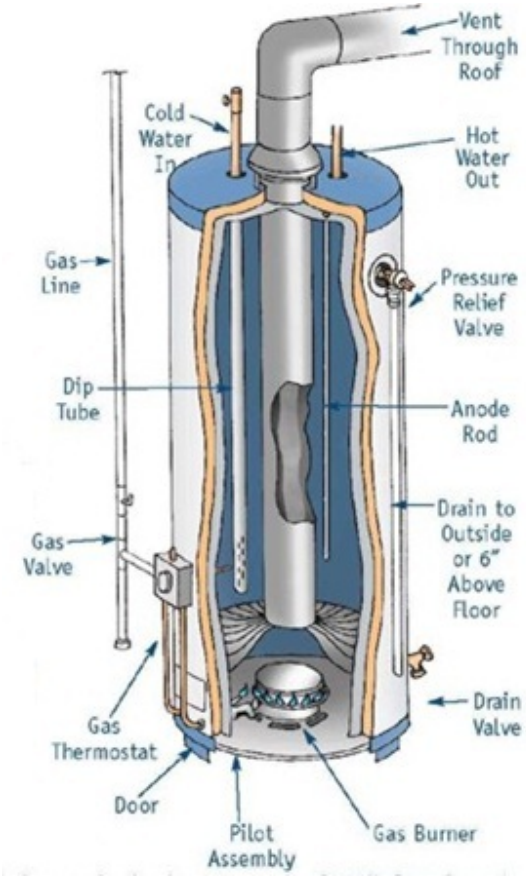


Gas Condensing Water Heaters

Condensing Gas Water Heater

Key Things to Know

- EF values > 0.80
- Annual savings over electric ~= $110/yr.
- Initial cost = $700 - $1200.
- Payback in 7 – 9 years.



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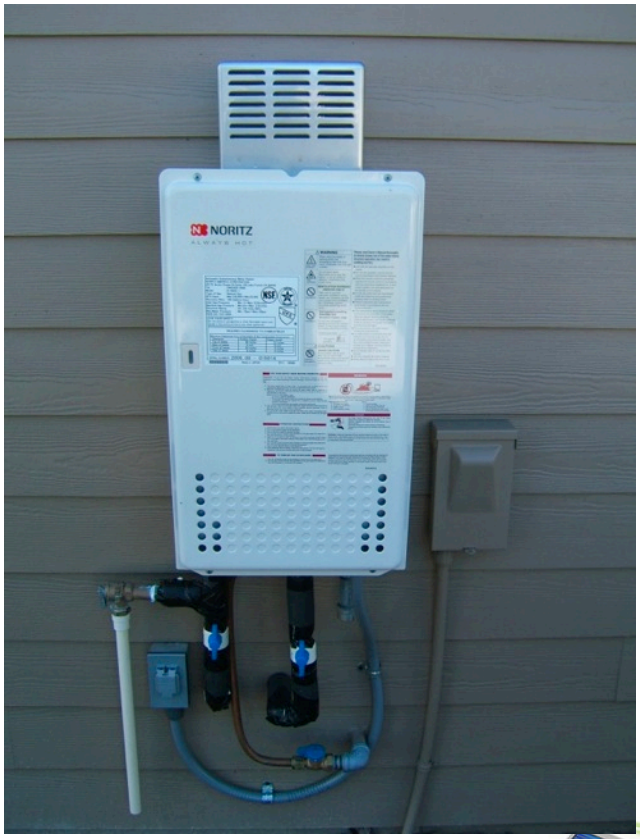
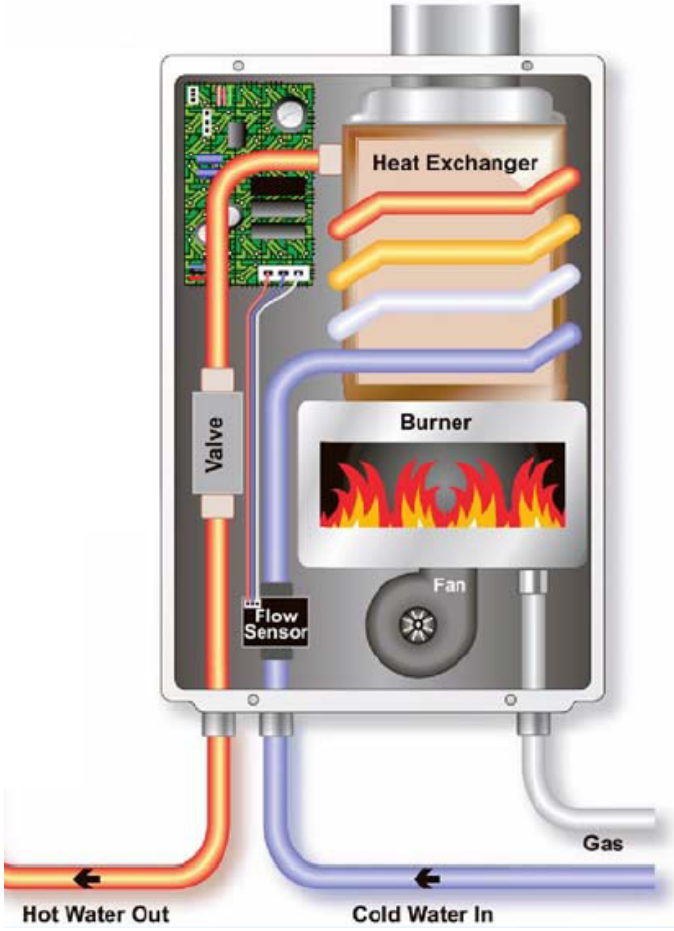
Tankless Gas Water Heaters

Tankless Water Heater



Key Things to Know

- Energy Star = 0.82 or higher
- Initial cost ~= 3 times greater
- Indoor or Outdoor units
- Payback in 6 to 8 years.



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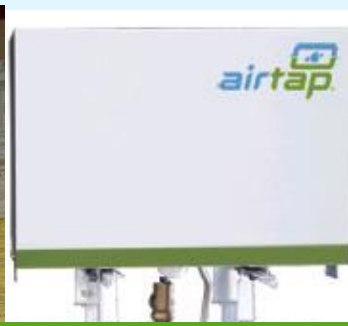
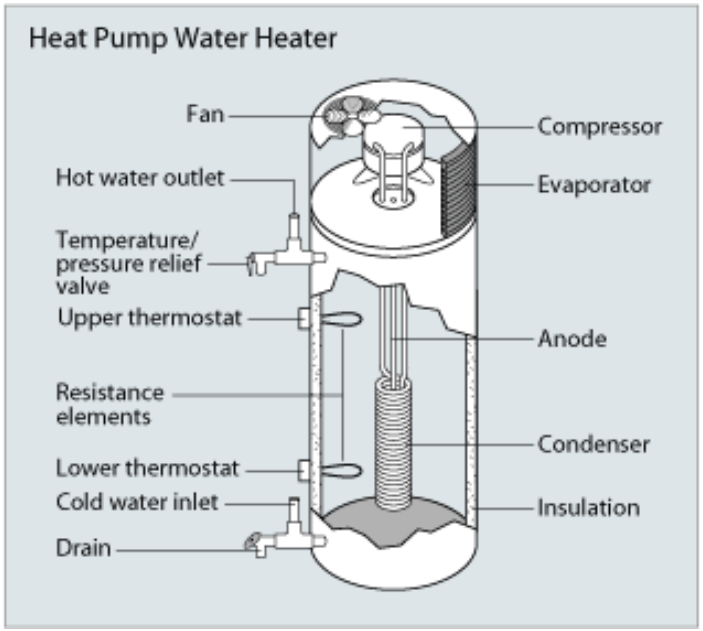


Heat Pump Water Heaters

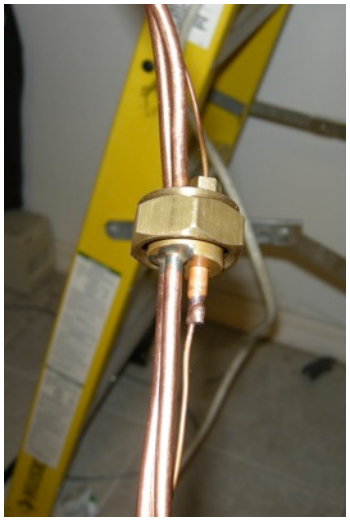
Heat Pump Water Heater

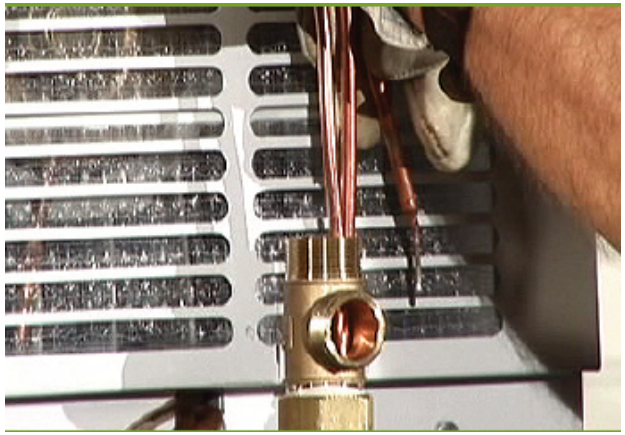
How Do They Work?



- Provides conditioned air as a byproduct of operation

AirTap HPWH Installation





AirTap Coil Installation

Video from airtap

Key Things to Know

- Energy Star = EF 2.0 and higher
- Two different types – integrated and retrofit.
- Provides conditioned air
- Initial cost about 2 times greater
- Payback in as little as 2 years.

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Solar Water Heaters

Solar Water Heaters

- Standard systems provided by manufacturers
- Various designs for
  - Climates
  - Freeze
  - Load sizes
- 80, 120 gallon systems
  - Single tank
  - Double tank
- Common components
- System certification

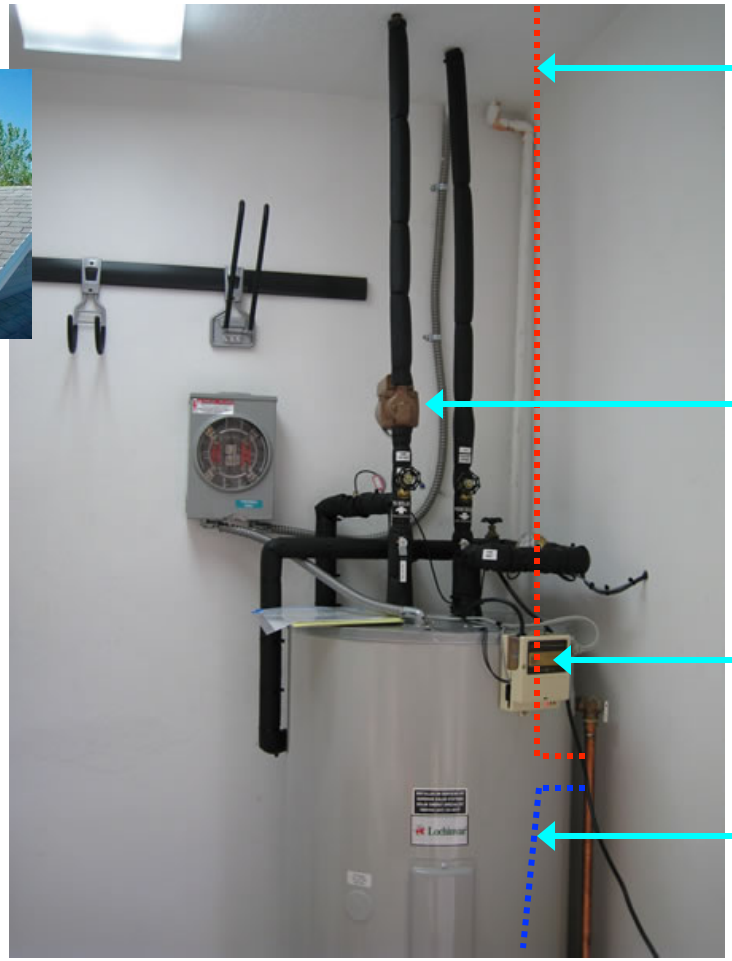
Passive Solar Water Heating Systems

- No pump or controller

Thermosiphon

Integral Collector Storage (ICS)

Differential Controller System



Sensor wire to collector

Pump

Controller

Sensor wire to tank bottom

Photovoltaic Powered Pump Systems

What you should know

- Solar systems should be certified
  - Certified systems go through tests to ascertain durability and performance
- You can compare collectors based on their projected energy output in Btus per day – the higher the better
- You can also use Energy Factors for systems

Home > Testing & Certification > Solar Thermal Collectors > Glazed Ratings > Z

Collector Certification (T-Z)

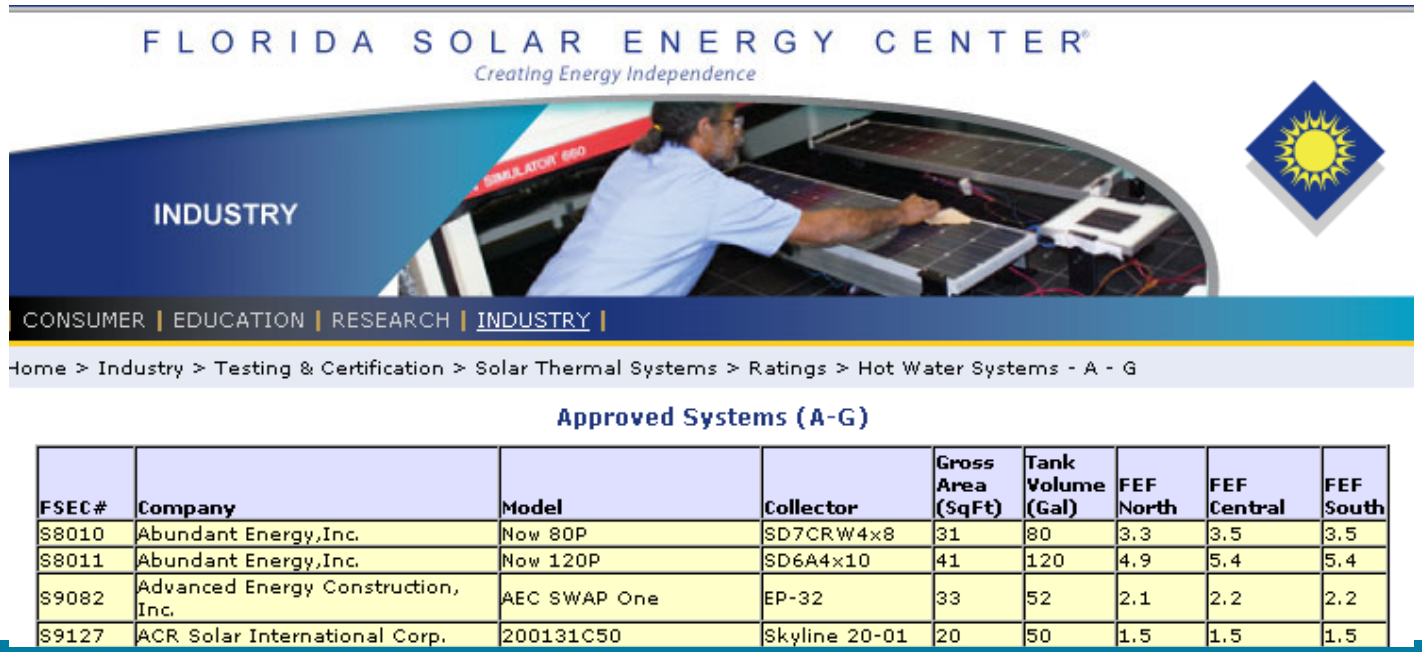
Collector			Glazing		Absorber		Gross Area	Thermal Performance Intermediate Temperature Rating	
Manufacturer	Model	FSEC #	No.	Type	Material	Coating	Sq. Ft	Btu/Day	Btu/ft²
Techno-Solis	TS-32	00454N	1	Glass	Copper tubes and fins	Selective	31.91	27500	862
Techno-Solis	TS-40	00455N	1	Glass	Copper tubes and fins	Selective	39.79	34400	866
Technosun Puerto Rico	50GSSHP	00053	1	Evacuated glass tube	Copper tubes and aluminum retainers	Selective	17.66	Thermosiphon System Net Energy Delivered: 9,900 Btu Heat Loss Coefficient: 2.5 Btu/hr°F	

FSEC Web Site

http://www.fsec.ucf.edu

SRCC Certification

http://www.solar-rating.org



Approved Systems (A-G)

FSEC#	Company	Model	Collector	Gross Area (SqFt)	Tank Volume (Gal)	FEF North	FEF Central	FEF South
S8010	Abundant Energy,Inc.	Now 80P	SD7CRW4x8	31	80	3.3	3.5	3.5
S8011	Abundant Energy,Inc.	Now 120P	SD6A4x10	41	120	4.9	5.4	5.4
S9082	Advanced Energy Construction, Inc.	AEC SWAP One	EP-32	33	52	2.1	2.2	2.2
S9127	ACR Solar International Corp.	200131C50	Skyline 20-01	20	50	1.5	1.5	1.5

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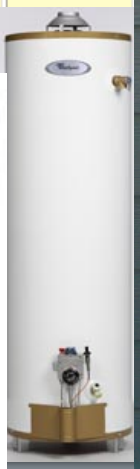
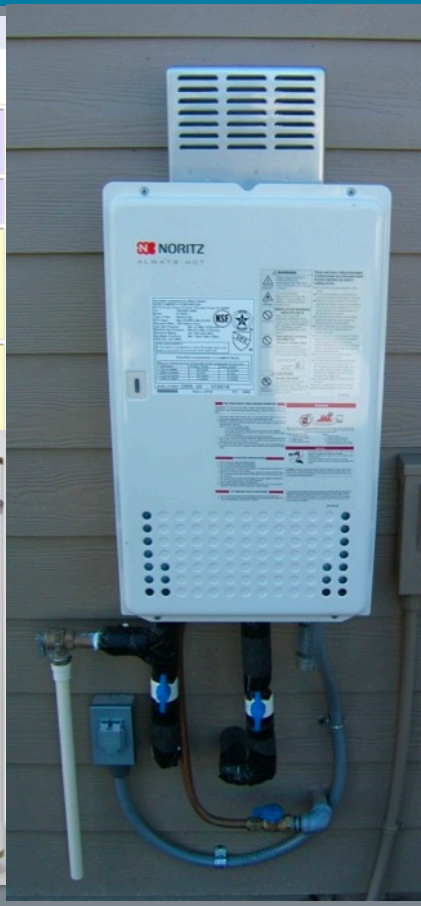
& Certification > Solar Thermal Collectors > Glazed Ratings > Z

Collector Certification (T-Z)

Collector			Glazing		Absorber	
cturer	Model	FSEC #	No.	Type	Material	Coating
Solis	TS-32	00454N	1	Glass	Copper tubes and fins	Selective
Solis	TS-40	00455N	1	Glass	Copper tubes and fins	Selective
					Copper tubes	





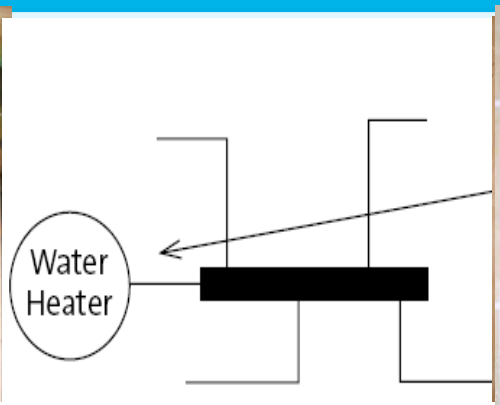
Comparing Energy Star Systems

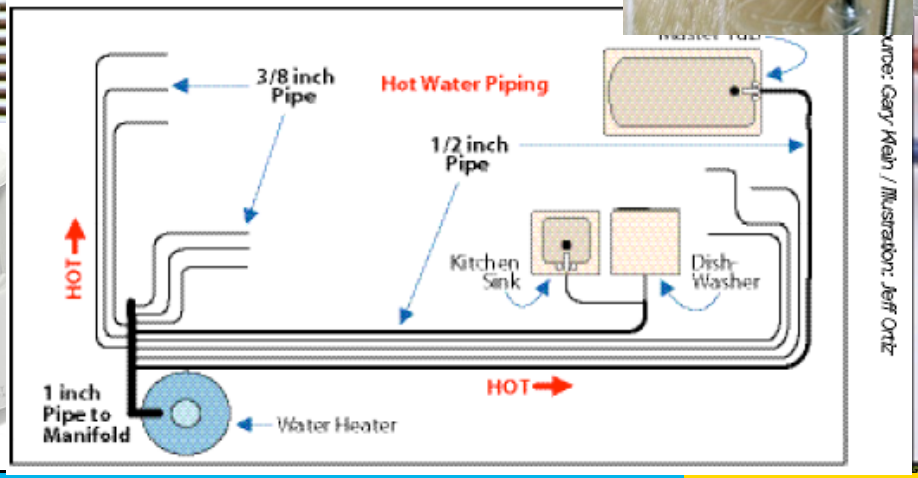
What Makes a Water Heater Energy Star?

Energy Star Criteria - see EnergyStar.gov				
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Gas Storage (Beginning 9/1/2010)	EF >= 0.67	FHR >= 67 gallons per hour	Warranty >= 6 years on sealed system	ANSI Z21.10.1/CSA 4.1
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Gas Condensing	EF >= 0.8	FHR >= 67 gallons per hour	Warranty >= 8 years on sealed system	ANSI Z21.10.1/CSA 4.1
ENERGY STAR Criteria	**Energy Factor**	**First-Hour Rating**	**Warranty**	**Safety**
Heat Pump Water Heaters	EF >= 2.0	FHR >= 50 gallons per hour	Warranty >= 6 years on sealed system	UL 174 & UL 1995
ENERGY STAR Criteria	**Energy Factor**	**Gallons-Per-Minute**	**Warranty**	**Safety**
Whole-Home Gas Tankless	EF >= 0.82	GPM >= 2.5 over a 77°F rise	Warranty >= 10 years on heat exchanger and 5 years on parts	ANSI Z21.10.3/CSA 4.3
ENERGY STAR Criteria	**Solar Fraction**	**Warranty**		**Safety**
Solar Water Heaters	SF >= 0.5	Warranty >= 10 years on solar collector, 6 years on storage tank, 2 years on controls and 1 year for piping and parts		OG-300 Certification from the SRCC

Hot Water Systems Laboratory

Video of Hot Water Systems Laboratory





Design and Distribution

Design Considerations

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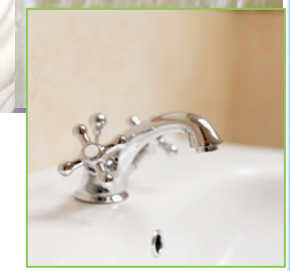
- Combustible vs. Non-Combustible
- Location within the home
- Number of occupants and needs
- Cost

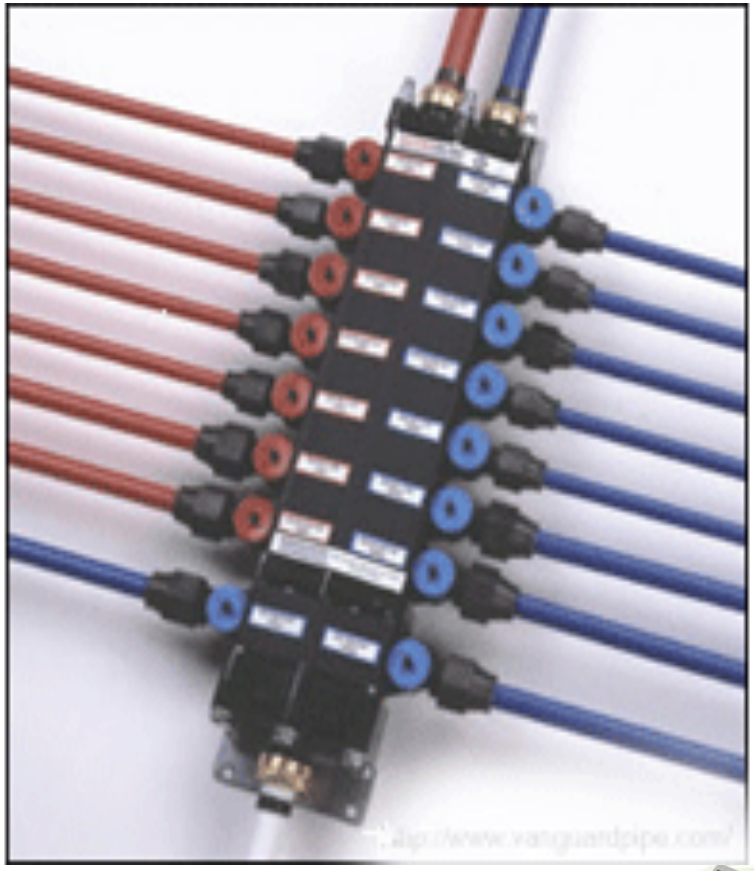
Reduce need for hot water

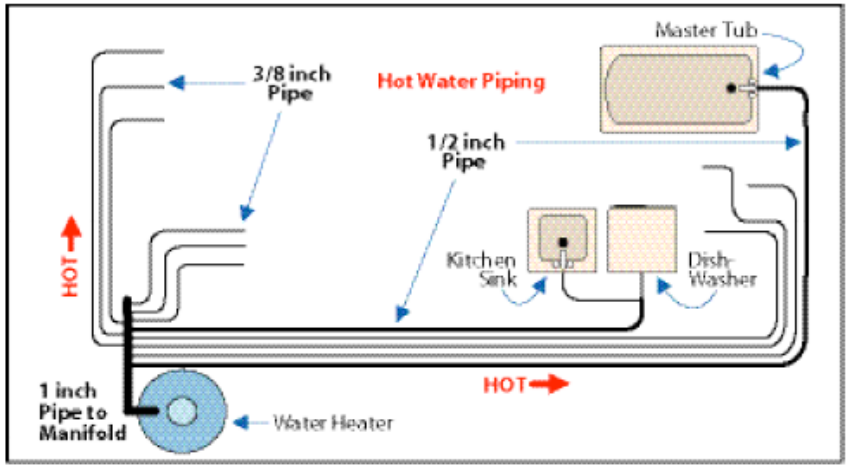


look for WaterSense Meets EPA Criteria

BA-PIRC

Water Distribution

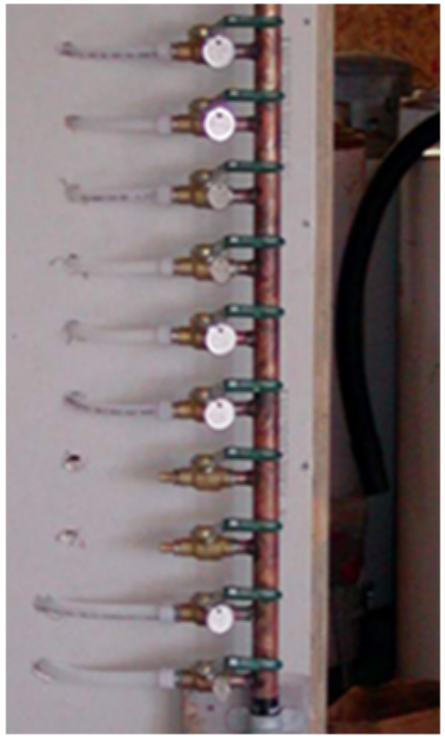




Source: Gary Klein / Illustration: Jeff Ortiz

A properly designed distribution system can:

- Reduce wasted water
- Provide individual hot water runs at each point of use.
- Reduce dishwasher power consumption
- Save you time and money



Saving Water and Time

- A twenty five foot run of ½" CPVC holds approximately 1qt. of water (31.2 fl/oz)

	Feet per Cup			
Type of Pipe	**3/8"**	**1/2"**	**3/4"**	**1"**
"K" Copper	9.48	5.52	2.76	1.55
"L" Copper	7.92	5.16	2.49	1.46
"M" Copper	7.57	4.73	2.33	1.38
CPVC	N/A	6.41	3.00	1.81
PEX	12.09	6.62	3.34	2.02

Source: Gary Klein

- The same length of 3/8" PEX holds only about ½ quart. (17.2 fl/oz)

Saving Water and Time

- It takes approximately 32 seconds for a 2.5GPM shower head to make a twenty five foot run.

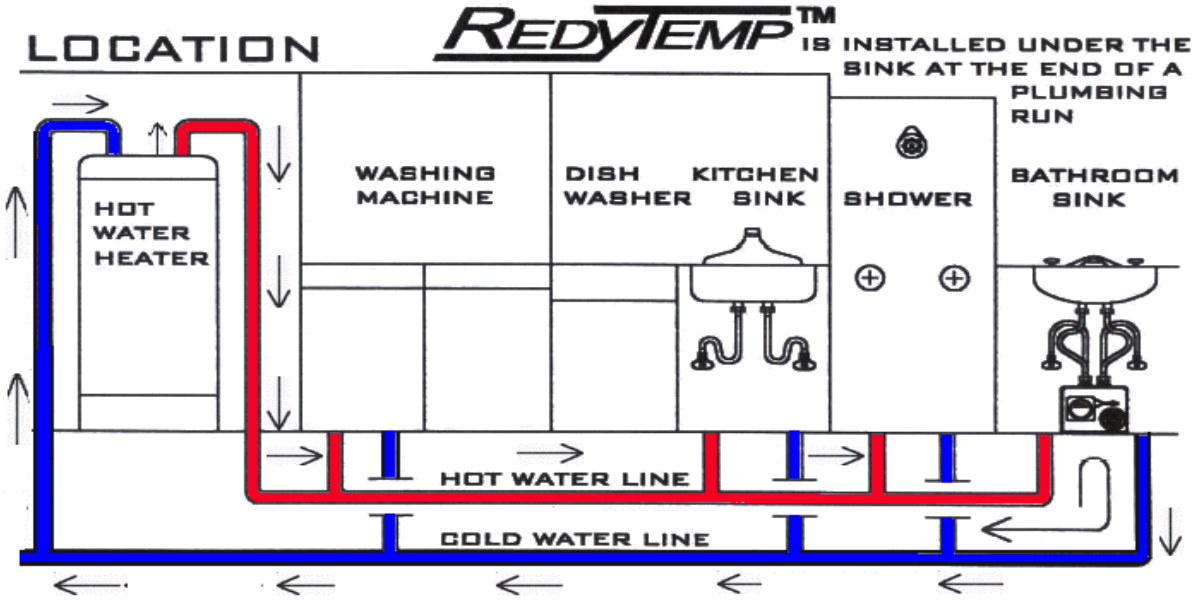
		Delivery Time in Seconds							
Fixture Flow Rate		0.5 GPM		1.5 GPM		2.5 GPM		4.0 GPM	
Piping Length	**Pipe Size**	**10 Feet**	**25 Feet**	**10 Feet**	**25 Feet**	**10 Feet**	**25 Feet**	**10 Feet**	**25 Feet**
Copper	1/2"	25	63	8	21	5	13	3	8
Copper	3/4"	48	119	16	40	10	24	6	15
Steel Pipe Schd 40	1/2"	63	157	21	52	13	31	8	20
Steel Pipe Schd 40	3/4"	91	228	30	76	18	46	11	28
CPVC Schd 40	1/2"	64	159	21	53	13	32	8	20
CPVC Schd 40	3/4"	95	238	32	79	19	48	12	30

	Acceptable Performance	1 - 10	seconds
	Marginal Performance	11 - 30	seconds
	Unacceptable Performance	31+	seconds

How Much Water Is Saved?

- ½” is today’s standard but 3/8” is more efficient
- 25’ of ½” CPVC = 3.9 cups/water
- 25’ of 3/8” PEX = 2.1 cups/water
- Savings = approximately 1300 gal/yr.

Recirculation Systems



System Selection

- Recirculation control types:
  - Continuous
  - Timer or Thermostatic

Activation Systems

- Recirculation activation types:
  - Manual
  - Automatically Sensed

Some Final Things to Consider.....

- Short runs and smaller diameter piping or pex lines
- Water conservation achieved through independent hot and cold water valves
- Pipe insulation
- Demand controlled hot water recirculation system

Bottom Line!

Water Heater Technology	Average Annual Savings*
High-Efficiency Gas Storage	$30
Gas Condensing	$110
Whole-Home Gas Tankless	$115
Solar	$220
Heat Pump	$290

* Savings for average household of 2.6 people.

Five types of water heaters can now earn the ENERGY STAR.

Find the one that's right for you

Bottom Line!

Water Heater type	Efficiency (EF)	Installed Cost[1]	Yearly Energy Cost[2]	Life (Years)	Total Cost (Over 13 Years)[3]
Conventional gas storage	0.60	$850	$350	13	$5,394
High-efficiency gas storage	0.65	$1,025	$323	13	$5,220
Condensing gas storage	0.86	$2,000	$244	13	$5,170
Conventional oil-fired storage	0.55	$1,400	$654	8	$11,299
Minimum Efficiency electric storage	0.90	$750	$463	13	$6,769
High-eff. electric storage	0.95	$820	$439	13	$6,528
Demand gas (no pilot)[4]	0.80	$1,600	$262	20	$5,008
Electric heat pump water heater	2.20	$1,660	$190	13	$4,125
Solar with electric back-up	1.8	$4,800	$175	20	$7,072

BA-PIRC

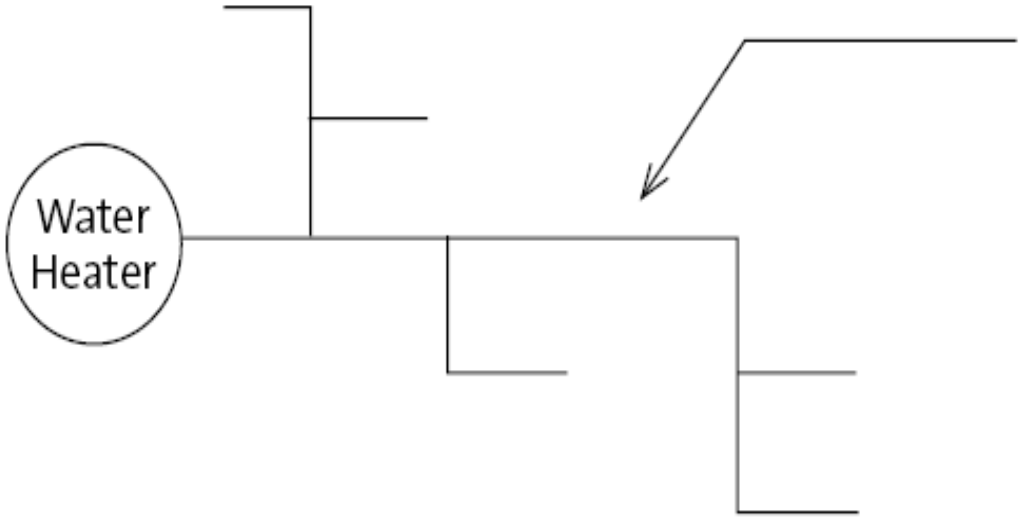
Green Home Program Overview

LEED for Homes Credit EA7.1

- Efficient Hot Water Distribution (2 points)
  - Design and install an energy-efficient hot water distribution system
  - Select one of the following designs

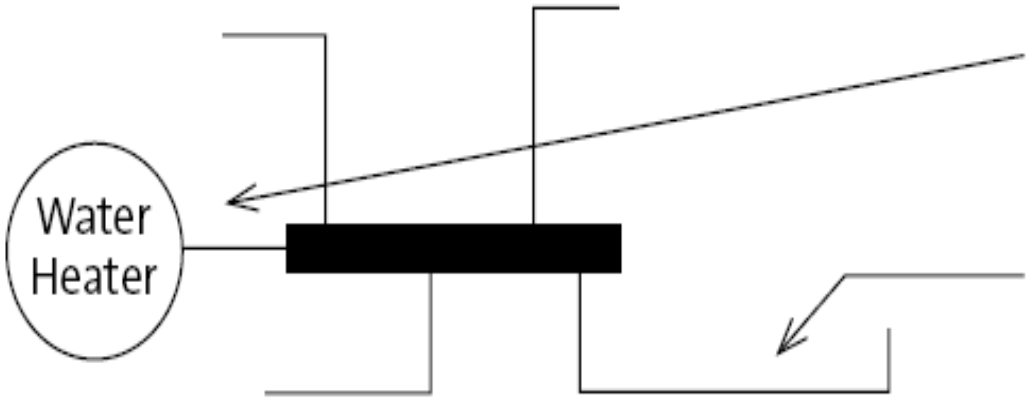
Compact Design of Conventional System

Sample Schematic of a Compact Design



Central Manifold Distribution System

Sample Schematic of a Central Manifold Distribution System

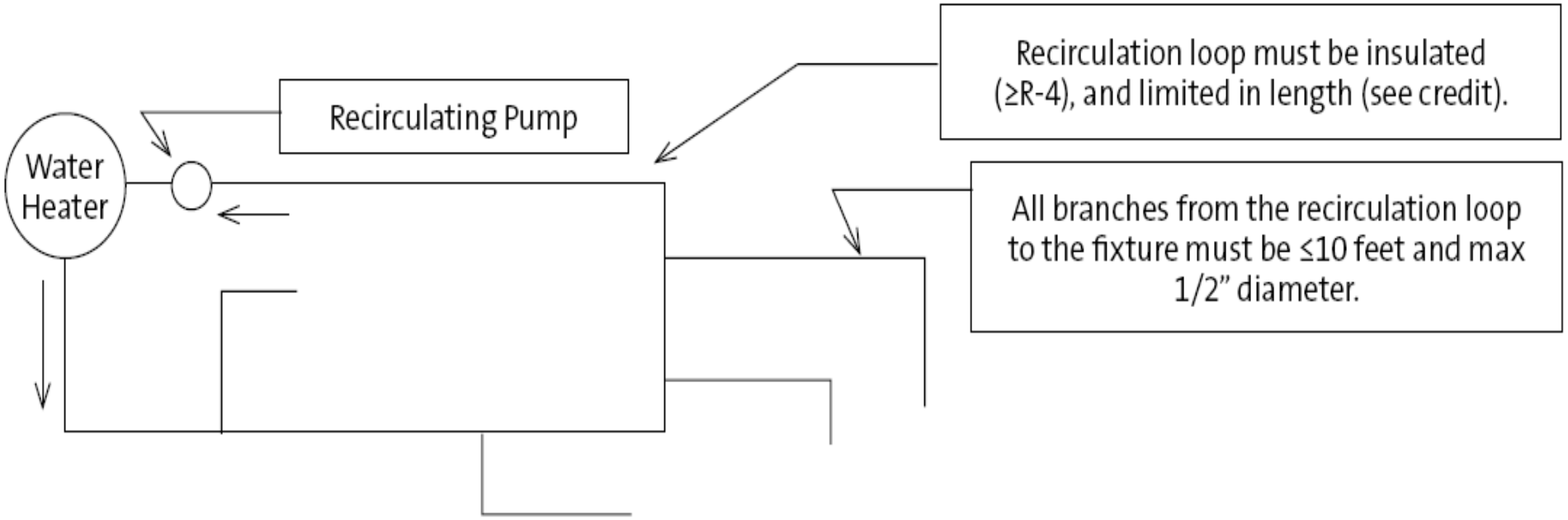


Trunk must be ≤6 feet from water heater and insulated to ≥R4

Home must have a tight plumbing core, with branches that are limited in length (see credit) and max 1/2" diameter

Structured Plumbing System

Sample Schematic of a Structured Plumbing System



Summary

- Five types of Energy Star certified Water Heaters
  - High Efficiency Gas
  - Gas Instantaneous (Tankless)
  - Gas Condensing
  - Heat Pump
  - Solar
- When looking at EF, compare apples to apples.
- Proper water line design and distribution can decrease both power and water use.

- Questions can be typed on the left of your screen
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  www.buildingamerica.gov/meetings.html