

Residential Water Heaters



Webinar

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DOE Webinar

Residential Water Heaters

Overview

Technology Options, for each type:

- Tech overview, consideration and issues

How to choose the right one

- Comparison of costs, needs, and performance

Energy Star Water Heater Criteria

Key Information for RFPs

Tools & More Information on Water Heaters

Technology Options

1. Storage water heaters

- Conventional, Condensing, Heat Pump

2. Instantaneous water heaters

- Conventional, Condensing

3. Tankless coil and indirect water heaters

4. Solar water heaters

Conventional Storage Water Heaters



Oil-Fired Storage Tank

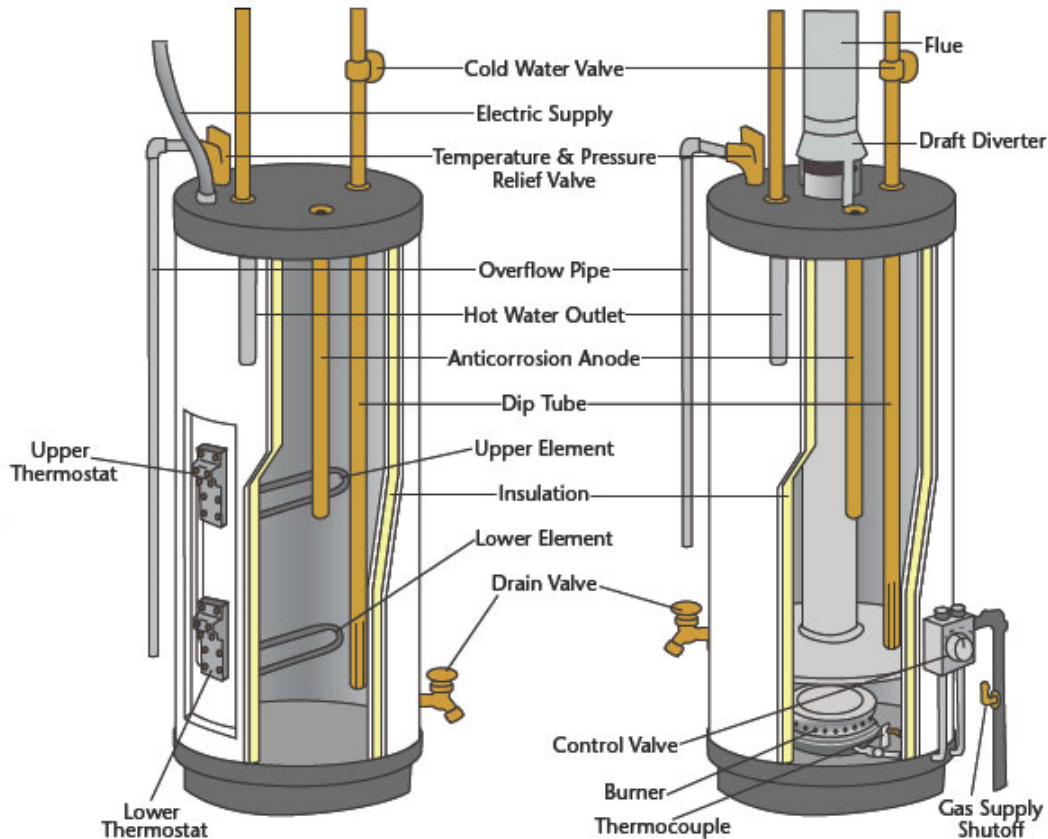


Gas-Fired Storage Tank



Electric Storage Tank

Technology Overview - Conventional Storage



- Fuels: Natural Gas, Propane, Fuel Oil #2, Electricity
- Burner or electric element fire to maintain a tank temperature set point
- Meets demand through storing capacity

Options - Conventional Storage

Venting

- Direct Vent
- Chimney



Considerations / Issues - Conventional Storage

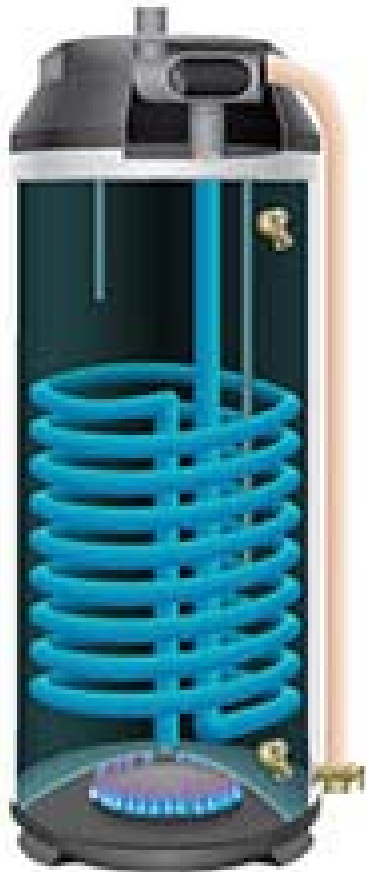
- Simple. Weatherization crews could install these. Plumbers understand these.
- Need a catch pan and drain for leaks or P/T relief valve opens
- If pilot ignition, no electrical power needed. Good for remote locations.

Condensing Storage Water Heaters



Condensing Gas-Fired Storage Tank

Technology Overview - Condensing Storage



- Fuels: Natural Gas, Propane
- Much greater surface area of flue pipe, more heat transfer and combustion gases condense giving up latent heat.
- Meets demand through storing capacity
- Typically, much larger gas input than a conventional storage water heater

Considerations / Issues - Condensing Storage

- New and complex device. Need a special technician to service or troubleshoot.
- Venting and combustion air through PVC out sidewall.
- Current models are for large loads.
 - Larger gas input than conventional fired storage tank. May need to upsize the current gas train.
 - Efficiency can be degraded from short-cycling when loads are small.

Heat Pump Water Heater

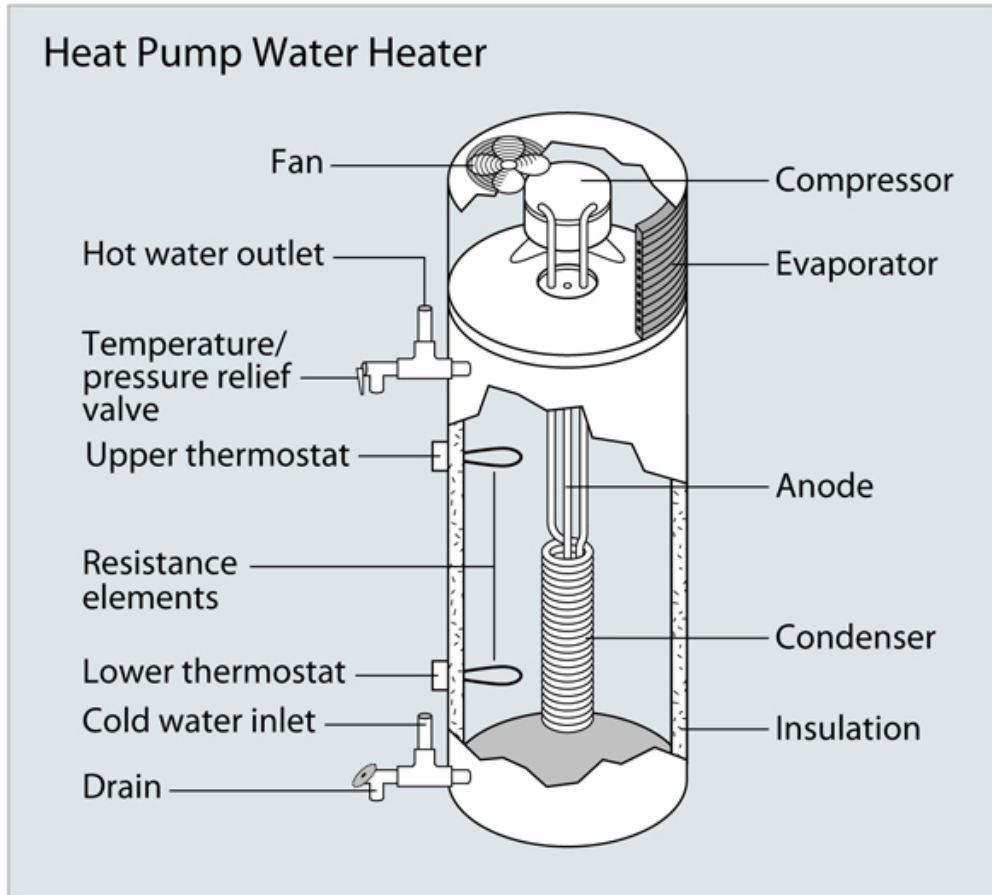


New Heat Pump Water Heater



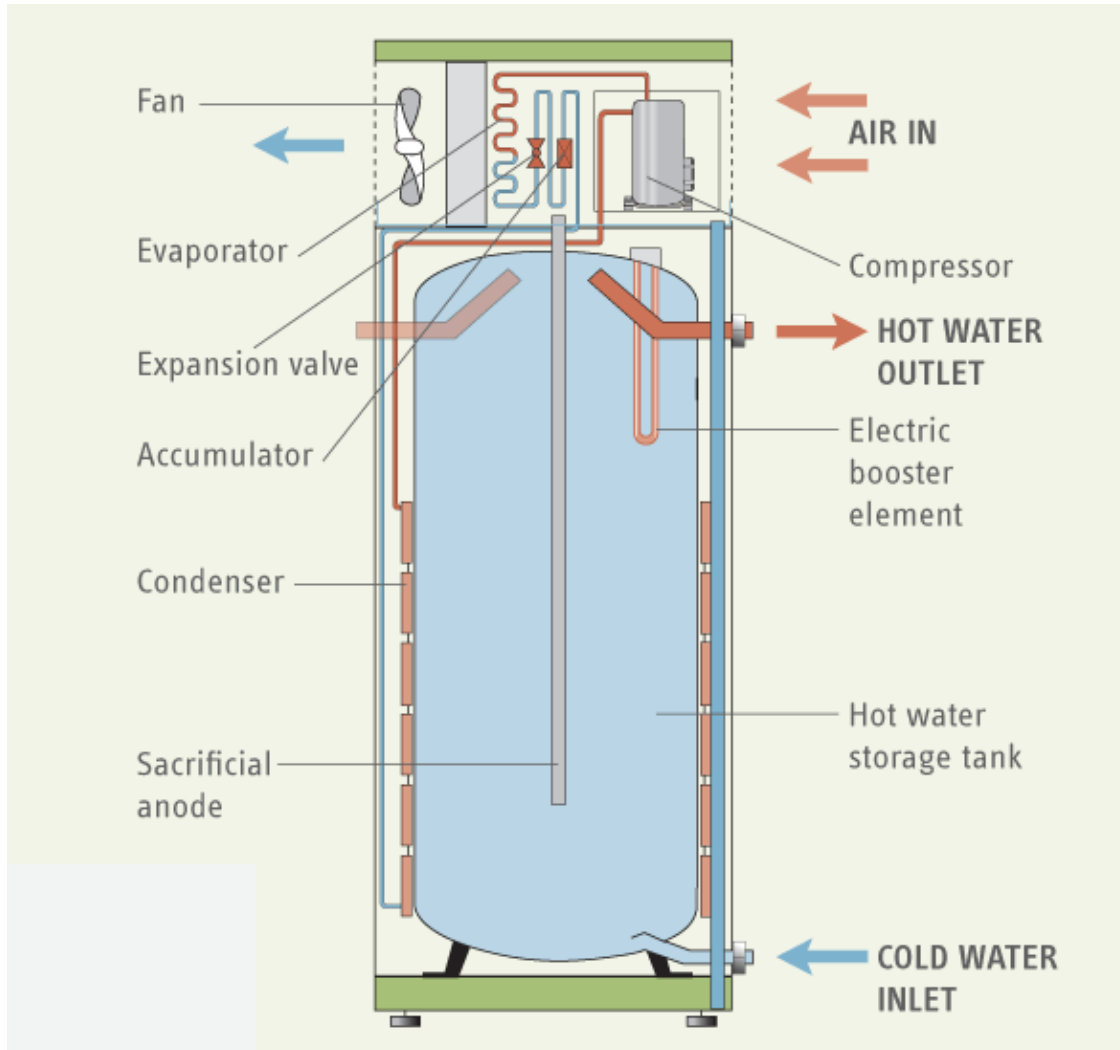
Retrofit Heat Pump Kit

Technology Overview – Heat Pump



- Fuels: Electricity
- Move heat from the environment into the water

Technology Overview – Heat Pump



Considerations / Issues – Heat Pump

- Install location must
 - Remain between 40° to 90°F
 - Be at least 1,000 cubic feet of air space
- Cool exhaust air can be exhausted to the room or outdoors. Install them in a space with excess heat, such as a furnace room.
- For heating dominated climates, install in the unconditioned basement. Provides some dehumidification!
- Additional cooling benefit when installed in conditioned space for cooling dominated climates.

Instantaneous Gas Water Heaters



Gas-Fired, Directly Vented,
Instantaneous Water Heater



Condensing Gas-Fired, Sealed
Combustion, Instantaneous Water
Heater

Instantaneous Electric Water Heaters



Electric, Central, Instantaneous
Water Heater



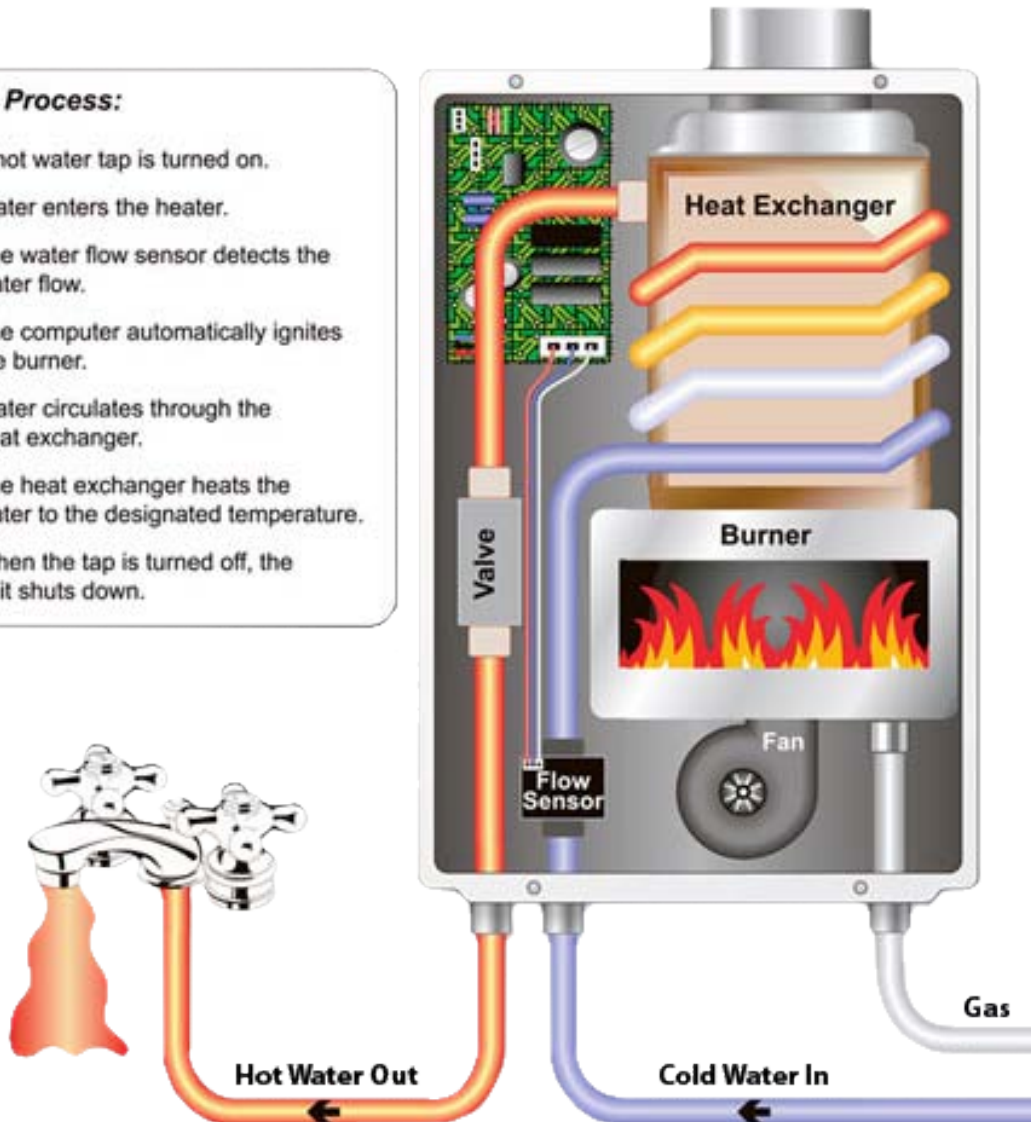
Electric, Point-of-use,
Instantaneous Water Heater

Technology Overview – Standard Gas Instantaneous

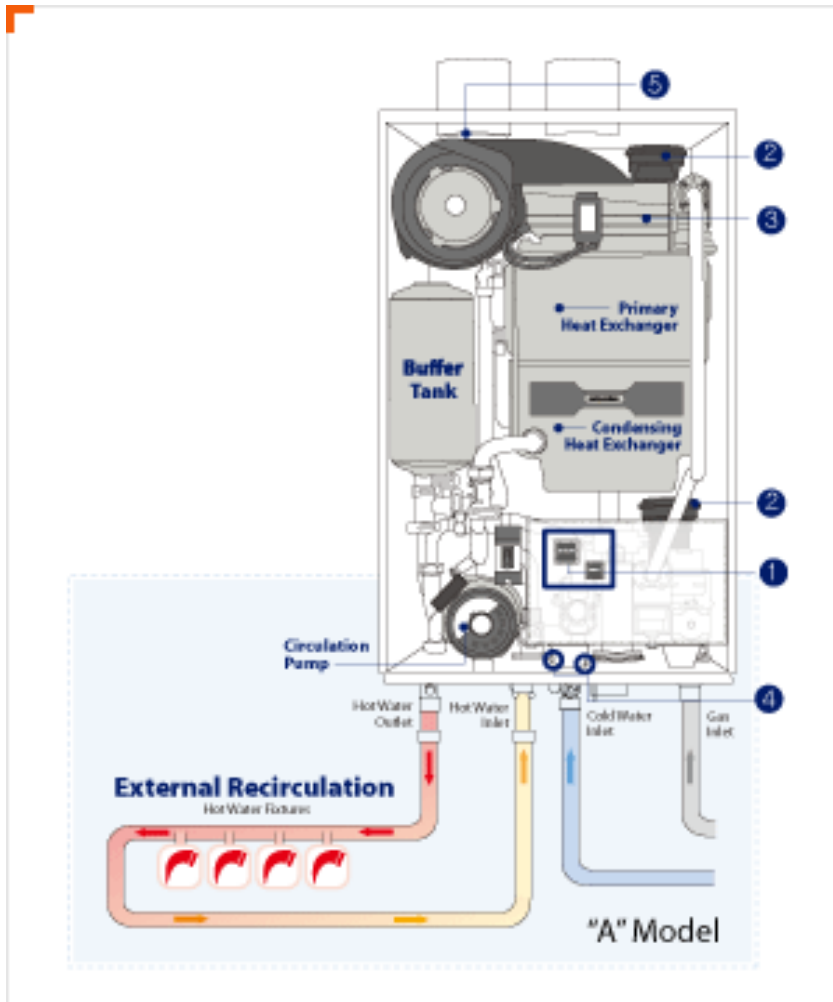
The Process:

1. A hot water tap is turned on.
2. Water enters the heater.
3. The water flow sensor detects the water flow.
4. The computer automatically ignites the burner.
5. Water circulates through the heat exchanger.
6. The heat exchanger heats the water to the designated temperature.
7. When the tap is turned off, the unit shuts down.

- Heats water through heat exchanger as needed
- No storage, minimal off-cycle losses

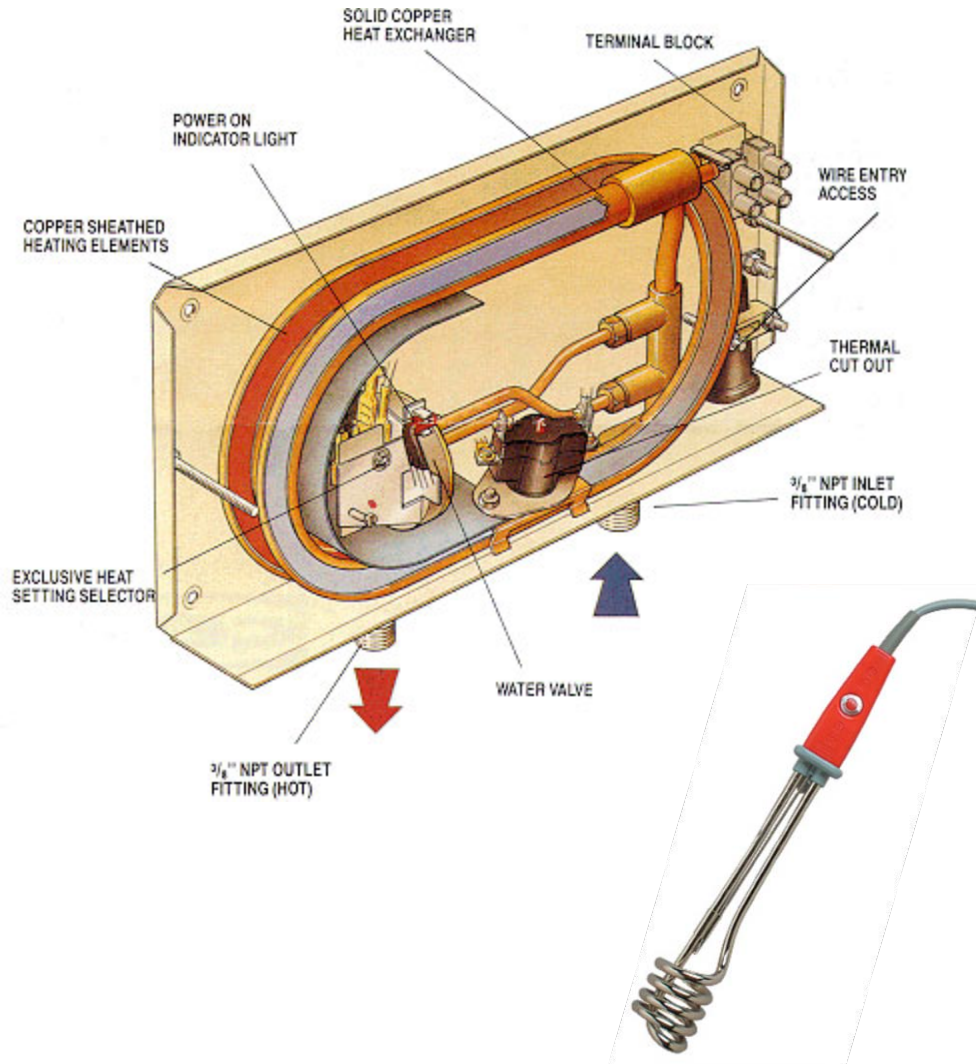


Technology Overview – Condensing Gas Instantaneous



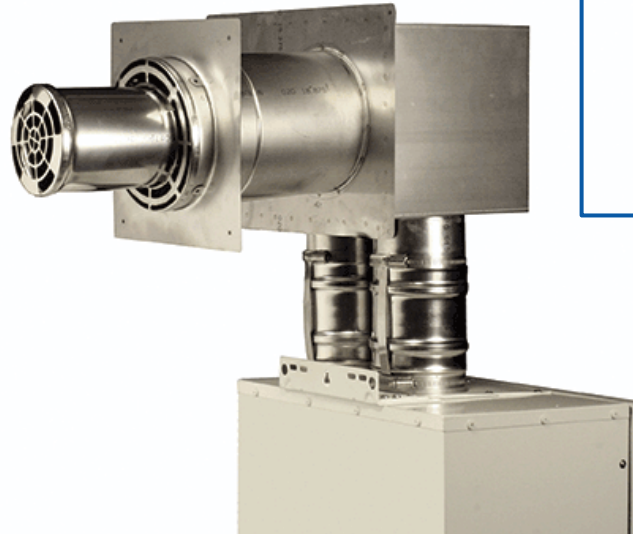
- Heats water only as needed
- Heats water through primary heat exchanger and extracts additional heat from secondary heat exchanger

Technology Overview – Electric Instantaneous



- Heats water only as needed
- Heats water through primary heat exchanger and extracts additional heat from secondary heat exchanger

Options - Gas Instantaneous



- Venting
 - Direct Vent
 - Sealed Combustion
- Ignition
 - Pilot
 - Spark , power
 - Spark, paddle wheel

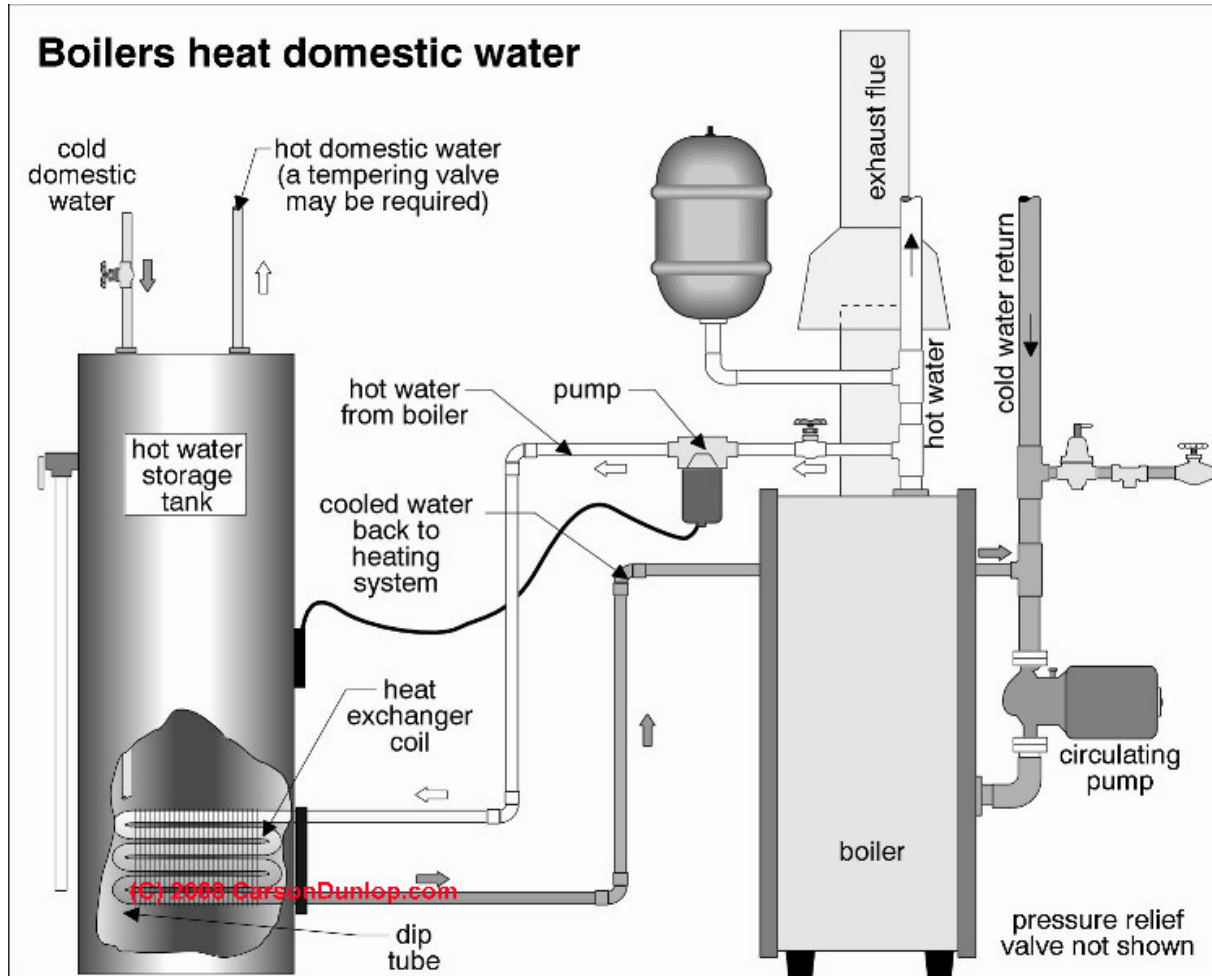
Considerations / Issues - Instantaneous

- Small profile, saves space
- Endless supply of hot water
- Central hot water or point-of-use?
- Must be sized according to usage demand and winter entering water temperature.
- Saves significantly more energy over conventional storage heater when usage in house is low.
- Clean hot water...no rust or built up scale from tank storage
- Lasts longer and require less maintenance than traditional tank water heaters
- Larger gas input than conventional fired storage tank. May need to upsize the current gas train.
- Condensing gas instantaneous is a new and complex appliance. Need a special technician to service or troubleshoot.

Indirect Water Heaters



Technology Overview – Indirect System



Source: CarsonDunlop.com

- Fuels: Natural Gas, Propane, Fuel Oil #2
- Good option if have hydronic heat already
- Needs proper design and controllers to optimize efficiency

Options – Indirect System



Source: Heat-Flo.com

- Heat Exchanger:
 - Coil inside of tank
 - Flat plate HX outside of tank

Considerations / Issues – Indirect System

- Eliminates having two combustion appliances
- Unfired storage tanks last longer than direct-fired storage tanks
- Complex system that require engineering design and a qualified plumber for installation
- Typically have a faster response and greater hot water output than a conventional direct-fired storage tank

Solar Hot Water Heaters

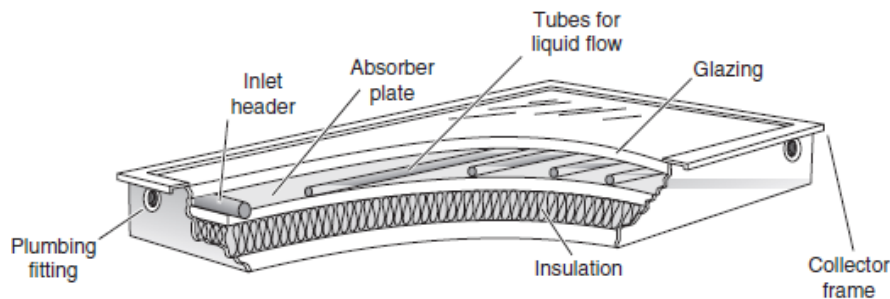
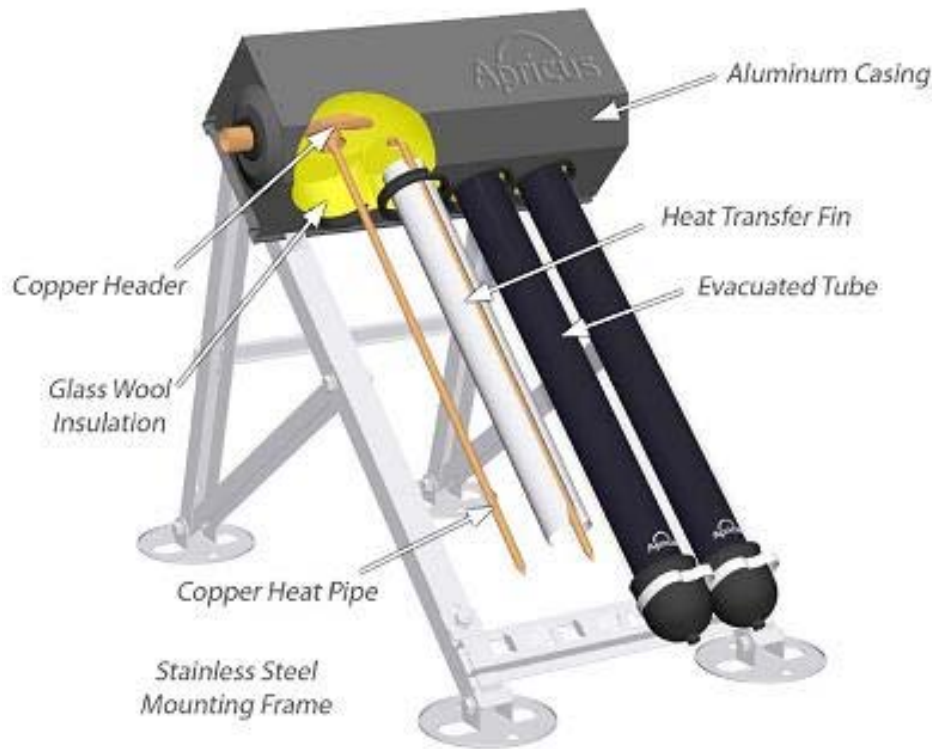


Evacuated Solar Tube Collectors



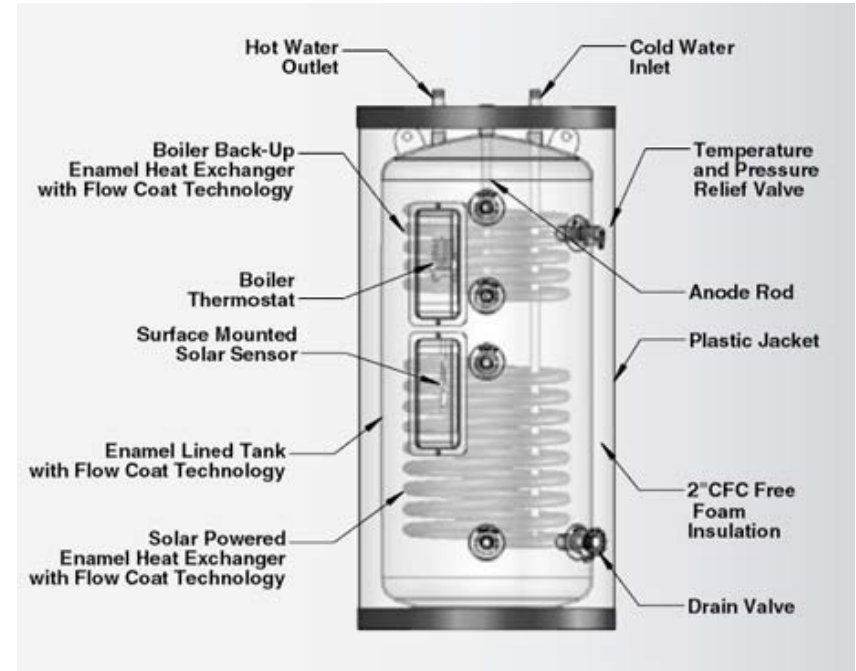
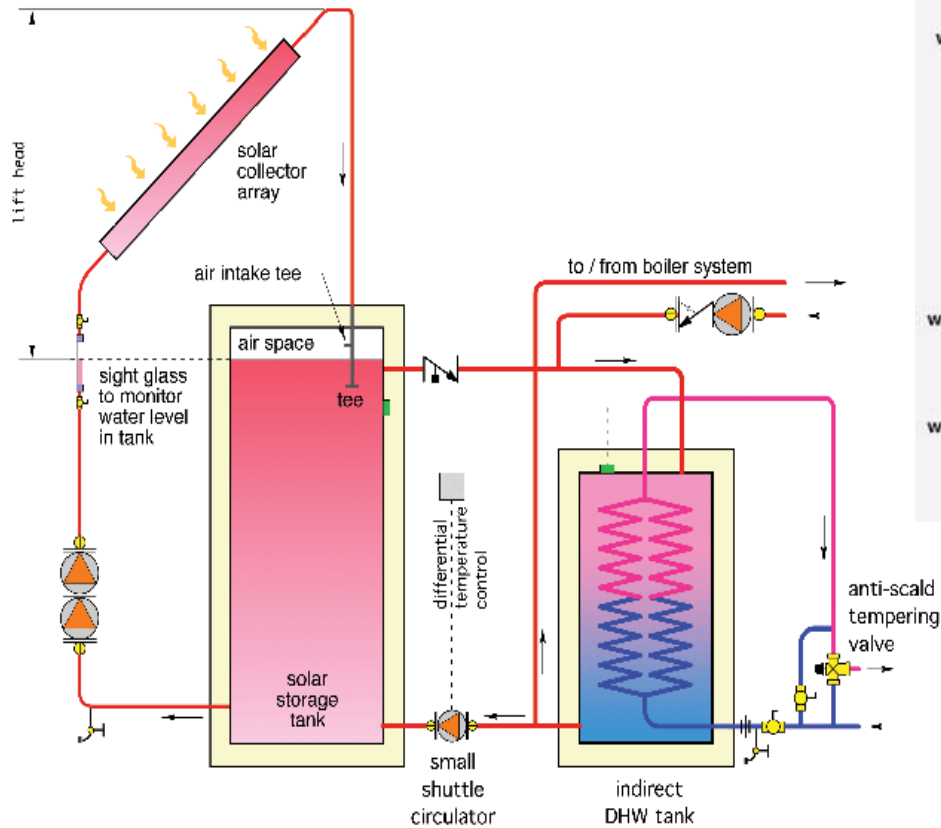
Flat Plate Solar Collectors with Storage

Technology Overview - Solar



- Fuels: Anything!
- Solar collectors absorb energy from the sun to heat the water
- System must include auxiliary heater, which can take any form

Technology Overview - Solar



Source: John Siegenthaler

Options - Solar

Direct or Indirect circulation system

Active or passive solar

Flat plate or evacuated tube collectors

What supplemental/auxilliary heat source?

Considerations / Issues - Solar

- Can be designed to cover up to 90% of the hot water load – Free energy!
- Reduces pollution and impact on global warming
- System requires routine maintenance
- Complex system requires engineering design and a qualified technician for installation
- Complex system requires a qualified technician for servicing
- Need mixing/tempering valve as storage temperatures can reach 180F

How to Choose the Right One



Selection Criteria

Fuel type, availability and cost

The fuel type or energy source you use for water heating will not only affect the water heater's annual operation costs but also its size and energy efficiency.

Hot Water Demand of House

To provide your household with enough hot water and to maximize efficiency, you need a properly sized water heater.

Energy efficiency

To maximize your energy and cost savings, you want to know how energy efficient a water heater is before you purchase it.

Installation Cost

Perform a financial analysis to determine which option is most cost-effective over the expected lifetime of the water heater. Consider using the incremental installation cost, when applicable.

Comparison of Technologies

Comparison of Water Heaters					
High Efficiency Water Heater Type	Energy Savings vs. Minimum Standards	Best Climates	Expected Energy Savings Over Equipment Lifetime	Expected Lifetime	Major Advantages
High Efficiency Storage (Tank) (Oil, Gas, Elec.)	10%–20%	Any	Up to \$500	8–10 Years	Lowest first cost
Demand (Tankless) Using Gas or Elec.	45%–60%	Any	Up to \$1,800	20 Years	Unlimited supply of hot water
Heat Pump	65% (Compared to electric resistance)	Mild-Hot	Up to \$900	10 Years	Most efficient electric fuel option
Solar with Electric Back-Up	70%–90%	Mild-Hot	Up to \$2,200	20 Years	Largest energy savings using a renewable energy source

Life-Cycle Cost Analysis

Water Heater Type	Efficiency (EF)	Installed Cost 1	Yearly Energy Cost 2	Life (years) 3	Total Cost (Over 13 Years) 4
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) 5	0.82	\$1,600	\$256	13	\$4,925
Electric heat pump water heater	2.20	\$1,660	\$190	13	\$4,125
Solar with electric back-up	1.20	\$4,800	\$175	13	\$7,072

1. Purchase costs include our best estimates of installation labor and do not include financial incentives.
2. Operating cost based on hot water needs for typical family of four and energy costs of 9.5¢/kWh for electricity, \$1.40/therm for gas, \$2.40/gallon for oil.
3. Life expectancy for water heaters is highly variable, largely dependent on water hardness, and on maintenance.
4. Future operating costs are neither discounted nor adjusted for inflation.
5. Currently, there is too little data to accurately estimate life expectancy for tankless water heaters, but preliminary data shows that tankless water heaters could last up to 20 years. For all water heaters, life expectancy will depend on local variables such as water chemistry and homeowner maintenance.

Source: <http://www.aceee.org/consumer/water-heating>

From EnergyStar.gov

Consider High-Efficiency Gas Storage if:

Currently have a gas storage water heater that needs to be replaced.

Willing to pay a little more upfront to reduce water heating bills by about 7%.

Want routine installation and maintenance.

Consider Whole-Home Gas Tankless if:

Often run out of hot water.

Have limited space and need a water heater that doesn't take up much room.

Want a water heater with a longer lifetime

Are willing to pay more upfront to reduce water heating bills by about 30%.

Have a large enough natural gas line in your home (typically at least 3/4") plus space to install the necessary venting.

Are willing to take on additional maintenance tasks or schedule a regular maintenance check every few years.

From EnergyStar.gov

Consider Gas Condensing if:

Often run out of hot water.

Willing to pay more upfront to reduce water heating bills by about 30%.

Have space to accommodate a condensate drain and special venting.

Consider a Heat Pump if:

Willing to pay more upfront to reduce water heating bills by about 50%.

Have space to accommodate a condensate drain.

Cooling dominated climate, good air intake source, and room size

Consider Solar if:

Have dependable access to sunshine on your roof or immediately outside your home.

Willing to schedule a regular maintenance check every year.

Willing to pay much more upfront to reduce water heating bills by as much as 80-90%, depending on location and design.

Energy Star Criteria & Tax Credits



Energy Star Key Product Criteria

ENERGY STAR Residential Water Heaters — Eligible Product Types

High-Efficiency Gas Storage	A nominal input of 75,000 BTU/hour or less and a rated storage volume from 20 to 100 gallons.
Gas Condensing	
Heat Pump Water Heaters	A maximum current rating of 24 amperes, voltage no greater than 250 volts, and a transfer of thermal energy from one temperature to a higher temperature level for the purpose of heating water. Unit must have "integrated" or "drop-in" configuration.
Whole-Home Gas Tankless	A nominal input of over 50,000 BTU/hour up to 200,000 BTU/hour and a rated storage volume of 2 gallons or less.
Solar Water Heaters	OG-300 rating from the SRCC. Auxiliary tank must be residential-class.

Check product availability. Find out what qualified models are available on the market http://www.energystar.gov/index.cfm?c=products.pr_find_es_products

Use the Special Deals Finder to determine whether there are rebates available for ENERGY STAR qualified water heaters in your zip code.

http://www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator

Utilize the Federal Tax Credits

http://www.energystar.gov/index.cfm?c=tax_credits.tx_index

Energy Star Key Product Criteria

High-Efficiency Gas Storage				
ENERGY STAR Criteria	Energy Factor	First-Hour Rating	Warranty	Safety
Gas Storage (Ending 8/31/2010)	EF \geq 0.62	FHR \geq 67 gallons per hour	Warranty \geq 6 years on sealed system	ANSI Z21.10.1/CSA 4.1
Gas Storage (Beginning 9/1/2010)	EF \geq 0.67	FHR \geq 67 gallons per hour	Warranty \geq 6 years on sealed system	ANSI Z21.10.1/CSA 4.1
Gas Condensing				
ENERGY STAR Criteria	Energy Factor	First-Hour Rating	Warranty	Safety
Gas Condensing	EF \geq 0.8	FHR \geq 67 gallons per hour	Warranty \geq 8 years on sealed system	ANSI Z21.10.1/CSA 4.1
Heat Pump Water Heaters				
ENERGY STAR Criteria	Energy Factor	First-Hour Rating	Warranty	Safety
Heat Pump Water Heaters	EF \geq 2.0	FHR \geq 50 gallons per hour	Warranty \geq 6 years on sealed system	UL 174 & UL 1995
Whole-Home Gas Tankless				
ENERGY STAR Criteria	Energy Factor	Gallons-Per-Minute	Warranty	Safety
Whole-Home Gas Tankless	EF \geq 0.82	GPM \geq 2.5 over a 77°F rise	Warranty \geq 10 years on heat exchanger and 5 years on parts	ANSI Z21.10.3/CSA 4.3
Solar Water Heaters				
ENERGY STAR Criteria	Solar Fraction	Warranty		Safety
Solar Water Heaters	SF \geq 0.5	Warranty \geq 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

Key Requirements for RFP



Key Requirements for RFP

- Specify that the equipment meet or exceed Energy Star criteria
- Designs for indirect and solar water heaters should be stamped by an engineer.
- The contractor shall properly dispose of all replaced water heater units and recycle in accordance with EPA guidelines.
- The bid proposal shall exclude any rebate(s) for products
- Conduct installation by certified/licensed contractors, subcontractors and/or employees in compliance with all applicable laws.
- Combustion venting to meet all local code requirements
- For solar, equipment shall be certified by Solar Rating and Certification Corporation (SRCC).

Tools and More Information

www.energystar.gov – general information on all technologies, tax credit info

www.energysavers.gov/your_home/water_heating – general information on all technologies

www.aceee.org/consumer/water-heating

www.ahridirectory.org/ahridirectory - performance certificates lookup by make/model

www.solar-rating.org/ - solar rating and certification of solar equipment

<http://www.solar-estimate.org> – estimate the size and cost of the new system

Questions and Answers

Thank you for your
participation!

Questions?