Hot Water Harvest from Your Woodstove

What this workshop is about

- We will discuss using or adapting an existing woodstove to provide hot water for various uses. These could include:
- Simple hot water storage in a side tank or reservoir
- Flue pipe or external heat capture plumbing
- Internal heat exchanger or “water jacket” (waterfront) plumbing
- Pumped and thermosyphon techniques for plumbed systems

Why should you do it?

- Wood is a sustainable resource and always locally available
- Heating water with wood is more economical than heating it with electricity or natural gas
- If you already heat with wood the installation can be fairly straightforward depending on how and where your woodstove is located.
- You can use a woodstove to heat water without a plumbing circuit in the simplest of setups

Why you may not want to do it

- Not all woodstove installations or residential living spaces are conducive to a hot water add-on
- If you use a plumbed system there are additional components involved and safety precautions that must be taken
- Harvesting hot water from a woodstove will diminish radiant heat output of the stove. Generally the simpler the system, the less impact it will have

- Insurance carriers may be reluctant to underwrite wood-heated domestic water systems because of lack of UL listing
- There are physical limitations. A typical woodstove will not produce enough hot water to heat a room with perimeter baseboard or radiant floor heating

Safety and Disclaimer

- Heating water in a closed loop or container will always involve a degree of risk if temperature or pressure goes beyond safety limits. Any closed system (one not opened to the atmosphere) <u>must</u> be equipped with working temperature/pressure relief valves placed at proper locations due to steam expansion
- Water trapped in heated pipes with no path for escape will become steam which expands to 1600 times the volume of liquid water and can burst pipes and containers with explosive force
- Respect your experience and know your limits. If a plumbed system is beyond your expertise, bring in a licensed contractor or consider a simple system.
- Woodstoves create enough heat to make scalding water. You may have to install a tempering valve to prevent scalds in a plumbed or pumped system
- Water quality can affect calcification and corrosion in pipes and critical components such as temperature/pressure valves, automatic air vents, and valves. You are responsible for maintenance on your system
- Never place a shut-off valve between the heat exchanger and the water storage tank without installing a pressure-relief device in line before the valve. A closed pipe can build up explosive pressure whether there is water in the system or not.

Side Tank or Reservoir Storage

- A separate tank or reservoir on the side of the woodstove, generally copper or stainless steel. Common on wood cookstoves
- Open to the atmosphere, not under pressure, equipped with removable or hinged lid
- Heat transfer from stove is moderate because it’s not physically in the firebox

- Can be fed with valved cold water supply and valved outlet for hot water
- Sized between 3 and 10 gallons capacity

External Heat Capture Plumbing

- Heat transfer from stove is moderate as with side tank designs
- Pipe surface area and total length should be maximized for best performance
- Impact on the heat output of stove is somewhat less than with internal designs because heat still radiates from free surfaces of the stove
- Can be applied to thermosyphon or pumped systems
- Side and top surfaces of the stove and the flue pipe are accessible in most woodstove designs
- Warranty and insurance issues are diminished since you are not directly modifying the woodstove

Internal Heat Exchanger or Waterfront

- Fits inside the firebox of the woodstove
- Heat exchanger is a single loop; waterfront is a narrow rectangular jacket with an inlet and outlet pipe
- Greatest heat gain of all designs and also most likely to overheat
- Requires drilling into a wall of the firebox and is a stove modification
- Will affect radiant heat output of the woodstove

Thermosyphon Systems

- The hot water storage tank must be positioned higher than the wood stove
- The tank should be located close to the wood stove to avoid long pipe runs

- The drain of the water heater tank must connect to the lower inlet of the heat exchange loop or waterfront
- The hot water piping coming out of the heat exchange loop or waterfront must go into the top of the water heater tank
- As a rule of thumb the cold water outlet or drain of the water heater tank should be at least one foot above the inlet of the heat exchange loop for every two feet of horizontal pipe run. This is a rise of at least 12 inches for every 24 inches of pipe run
- Larger piping works best for thermosyphon systems. Use 3/4″ copper pipe minimum or 1″ copper if budget allows
- Avoid 90 degree elbows or Tee fittings (Tees can be used to mount devices such as temperature/pressure relief valves or air bleeders). A 90 degree sweep will be much less restrictive than an elbow
- Redundant pressure/temperature relief valves are required, one on storage tank and one each on inlet and outlet piping from heat exchanger

Pumped Systems

- Requires some design expertise and attention to detail
- Highest recovery rate
- Greater investment because of component costs of pump, control switch, expansion tank, check valve, and tempering valve
- Does not require hot water storage tank to be positioned higher than the woodstove
- Redundant pressure/temperature relief valves are required, one on storage tank and one each on inlet and outlet piping from heat exchanger
- Pumped systems need safety considerations such as a system drain option or battery back-up for the pumps in the event of power outage

Resources

http://www.woodheat.org/heating-water-with-a-wood-stove.html http://solarhomestead.com/using-your-wood-stove-to-heat-water/

http://www.engineeringtoolbox.com/water-content-steel-copper-pipes-tubes-d_1617.html

zoro.com

SupplyHouse.com

Notes:

Thermosyphon or convection flow systems are the most reliable because they don't use a pump or electricity. They must be installed with a good amount of rise and be designed to flow freely to assure efficiency

Safety relief devices (125F temperature/pressure relief valves) are critical in any closed system. One at the inlet and outlet of the heat exchanger and one at the highest point in the system. They are designed to release long before the water turns to steam and jeopardizes system pressure

Domestic water systems with city water are more vulnerable to over-pressure because they don't have a pressure tank to absorb volume. The tank keeps system pressure down and prevents relief valves from opening. The addition of a small expansion tank usually resolves this

The storage tank must be sized large enough to absorb the heat from burn cycles between each water use cycle. This will avoid overheating and help with slow heat recovery rate

Only copper, stainless steel, brass, or iron pipe is resilient enough to handle the heat of these systems. Plastic, including radiant-heat PEX, will fail at high temperatures. Use stainless steel for firebox loop heat exchangers, since copper will anneal and soldered joints will fail at high temperatures.

Estimation of Btu requirements and heat recovery:

Water volume .0251 gallons/ft. 3/4” copper pipe

Inlet temperature 60 degrees F, outlet 140 degrees F, with Delta T 80 F

41 gallons in storage equals 342 lbs. of water (8.33 lbs. per gallon)

342 x 80 = 27,360 Btu; 27,360 / 3,412 = 8.0 kWh (3,412 Btu per kWh)

(example only; performance will be affected by pump rates and system losses)