

NEW HAMPSHIRE
PUBLIC UTILITIES COMMISSION

Solar Thermal Domestic Hot Water
Systems

by
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Solar Thermal Auditor/Inspector

Solar Thermal Systems in Mass.

- Job Growth: Solar has seen an 18% job growth.
- Installers account for 68% of that growth.
- Currently 64,000 employed in Mass.
- A 15.2% growth expected July 2011 to July 2012



Customers

Initial Contact and Marketing

- Website
- Trade shows and conferences
- Local Energy Fairs
- Educational Presentations to Sustainable Groups and Schools
- Networking with General Contractors, Architects, and Engineers
- Referrals
- Google AdWords (pay only when people click on your site)
- Print Advertising



Project Development

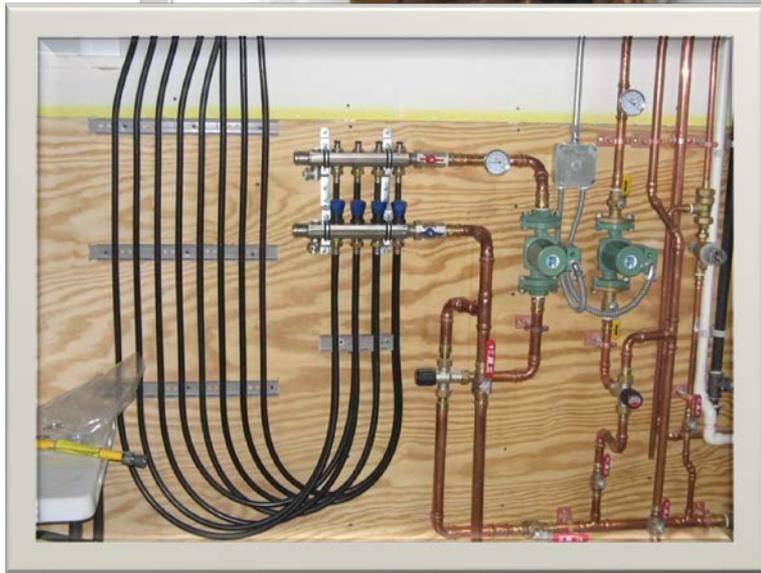
Residential/Small Commercial Site Visit

- Pictometry/Google Earth Analysis (ruler)
- Solar Pathfinder Analysis
- Get to know your customer and their goals
- SDHW, Space Heat, Pool Heating?
- Roof Structure
- Pipe Chase
- Existing Mechanicals
- Determine location for proposed system
- Educate customer on thermal system options that best suit their needs
- Obtain 1 to 2 years of oil, gas and/or electric usage



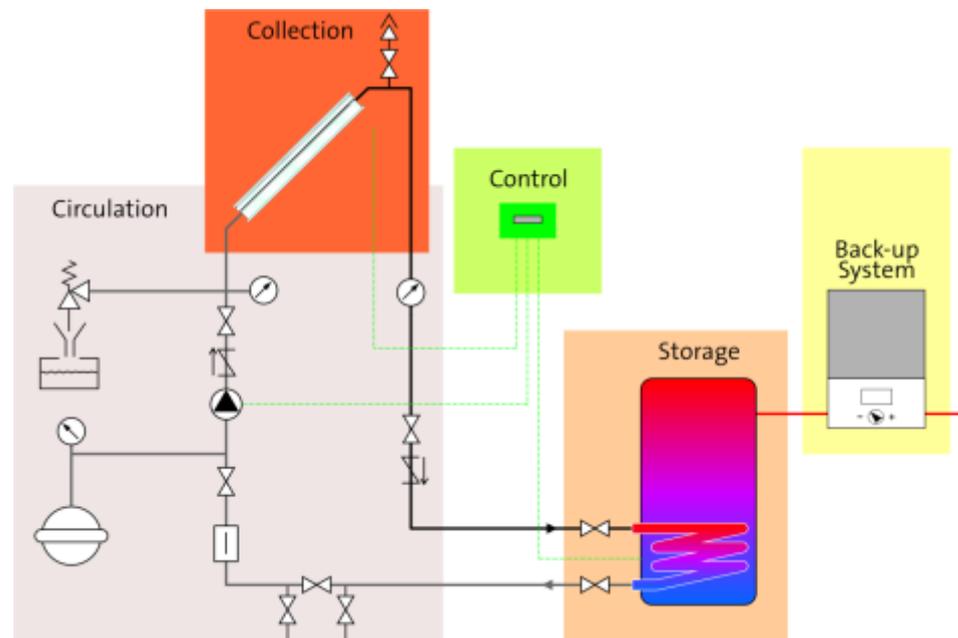
System Installation

- Signed Contract
- File NH PUC Rebate Application, if applicable and get approval
- Consider data monitoring
- Building and Plumbing Permit
- Install
- Permit Sign offs
- Train customer on all system components and operation
- Package system schematic with spec sheets and warranties, maintenance schedule
- Check back with customer frequently (6 mo.)



Pressurized Glycol Antifreeze Systems

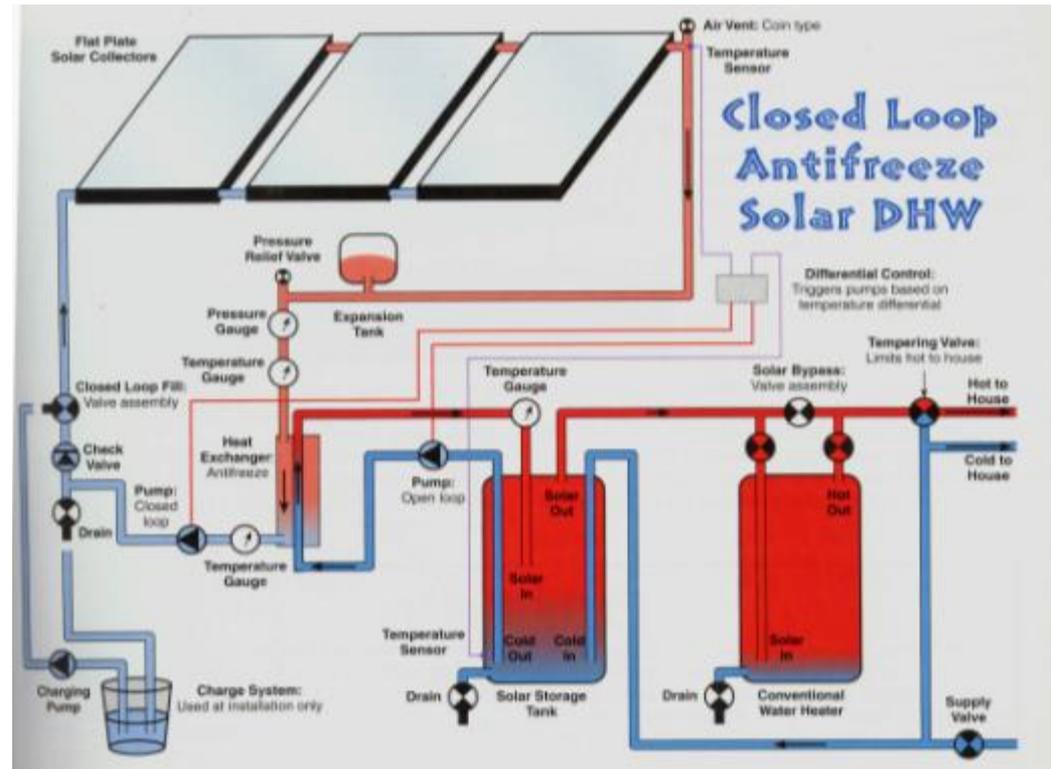
- Expansion tank
- Check valves
- Circulating pump
- Air vents
- Ball valves
- Pressure relief valves
- Single and double coil hot water tanks
- Copper tube and fittings
- Collectors
- Differential thermostat



Heat exchanger:
Immersed vs. external.

Types of Systems for the Northeast

- Pre-packaged
- External heat exchanger
- Existing Electric water heater as backup

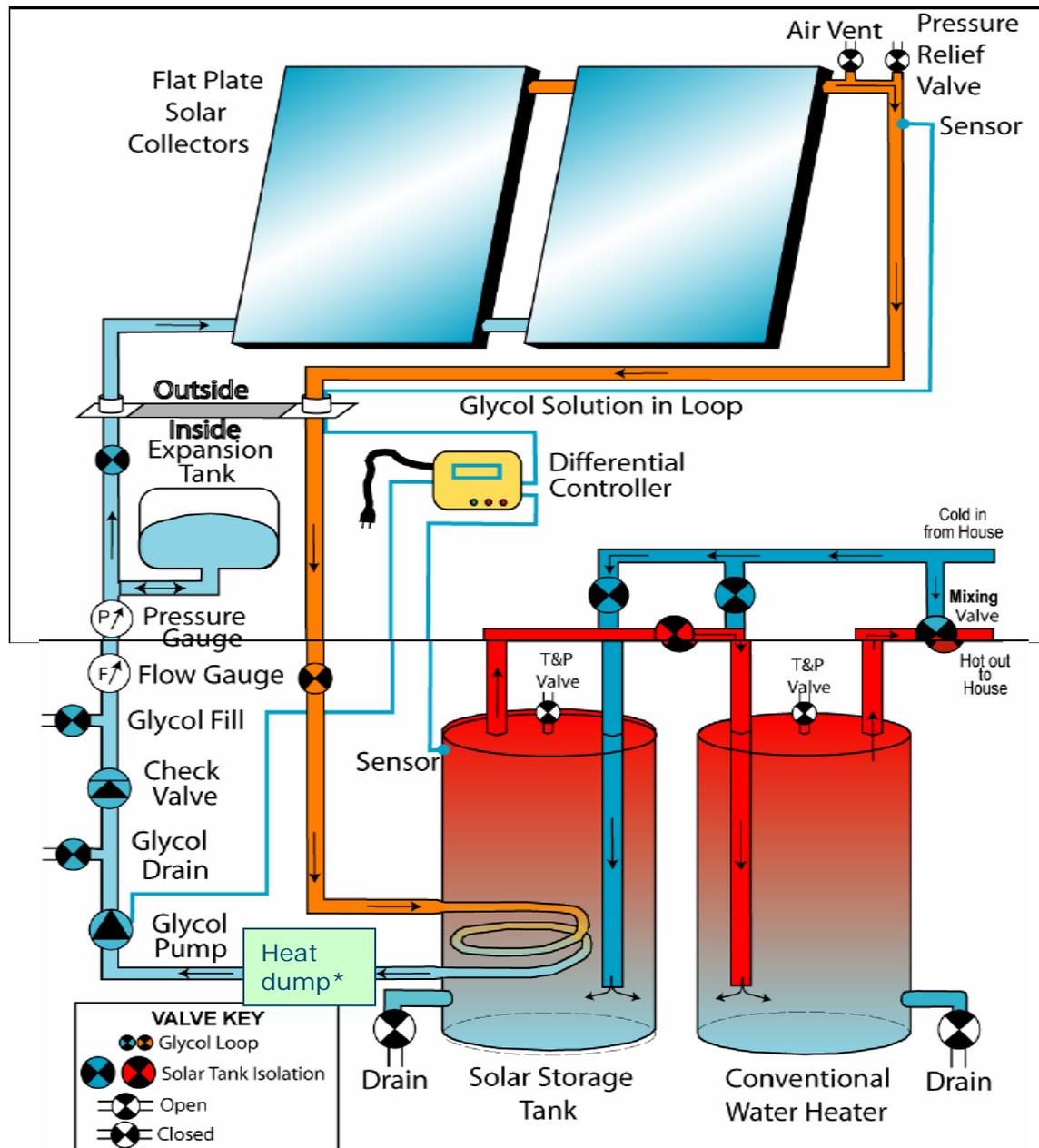


* Any mixture ratio beyond recommendations lower efficiency.

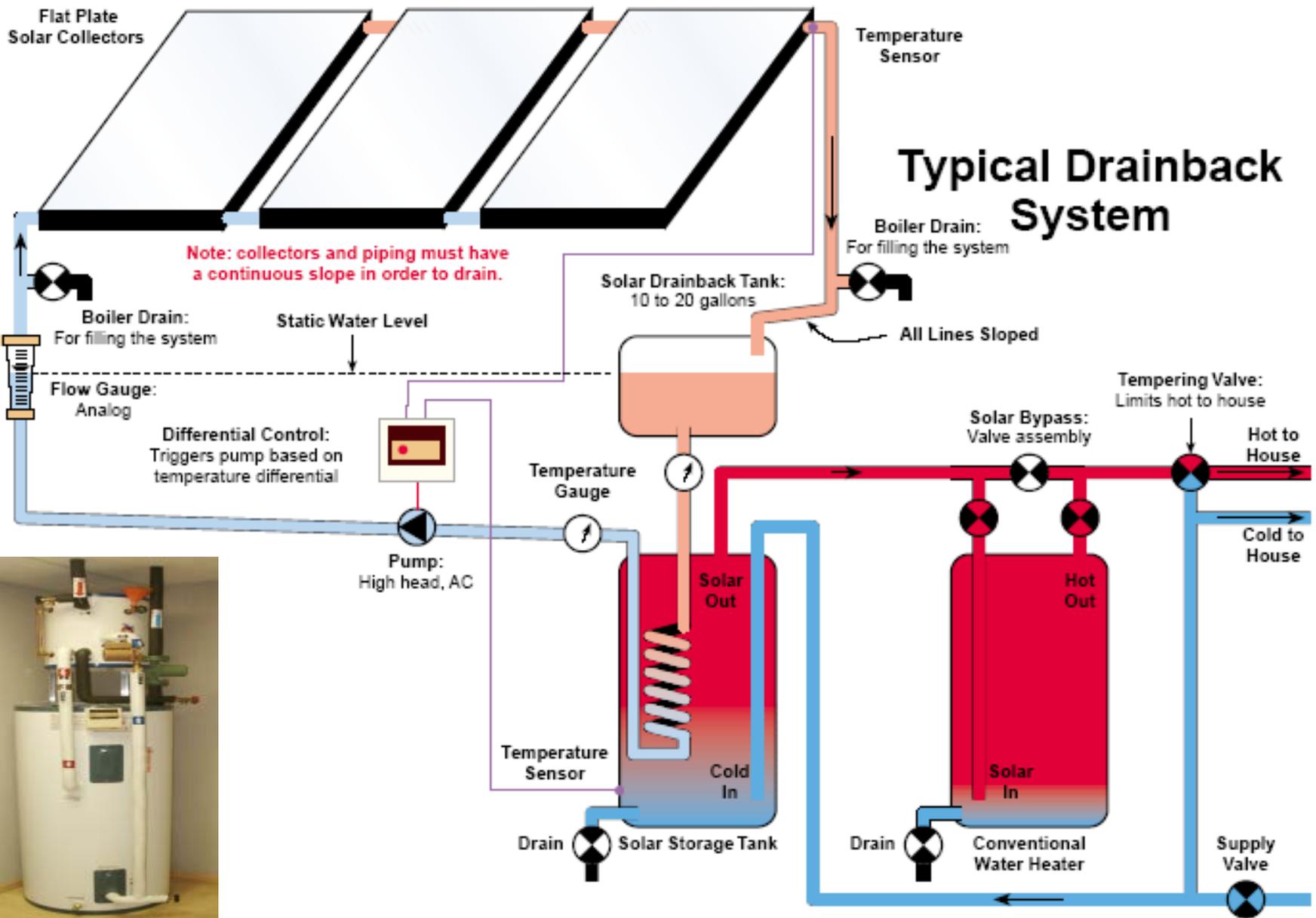
Closed Loop Antifreeze System with Heat Dump

*Heat dump can be useful for basement de-humidification it can be done with an aquastat opening a valve to go through baseboard zone OR with a kickspace heater with a temperature switch. When the solar collector fluid is above the set point heat is moved to living space by turning on a fan.

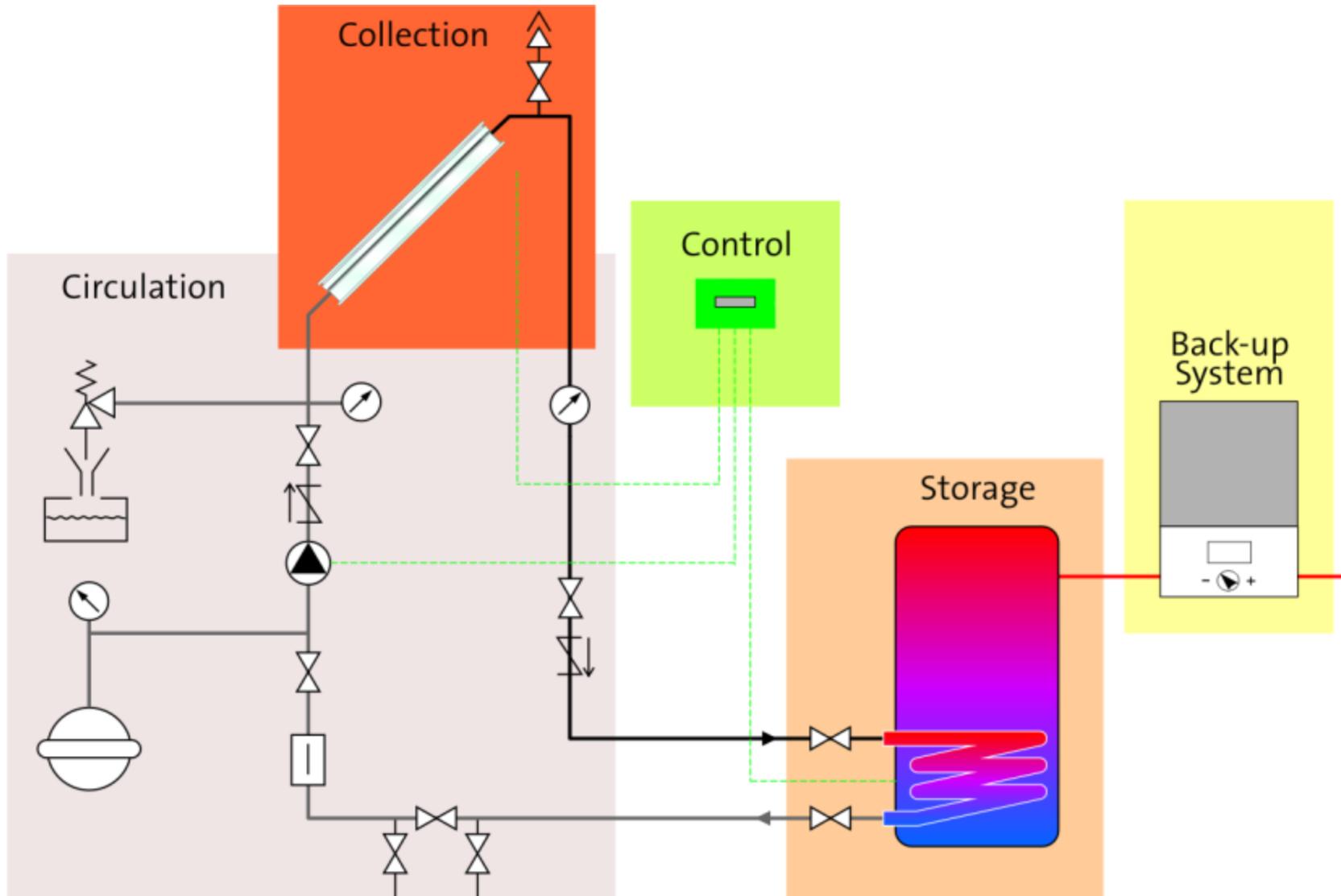
A Modine kick-space heater is less expensive than an extra aquastat, three way valve, and length of baseboard, and could save the customer \$600/yr. in power bills



Types of Systems for the Northeast



Internal Heat Exchanger



Pre-Packaged System (with tags)



Double-Coiled Tank With Pre-Packaged Solar System



Pre-packaged system with gas hot water heater backup



(Note covering)

External Heat Exchanger



Pros & Cons

Safety Valves Required
On All Tanks Over 15 PSI
Capable of Heating Water Over 200 deg. Fah.

- **Full flow shut-off**
- **Vacuum relief valve**
(above the top of the tank, it prevents hot water from being drawn back into cold water)



Safety Valves Continued

- **Temperature relief valve**
- **Pressure relief valve**
(can be combined)
- **Tempering valve**



Safety Valves III



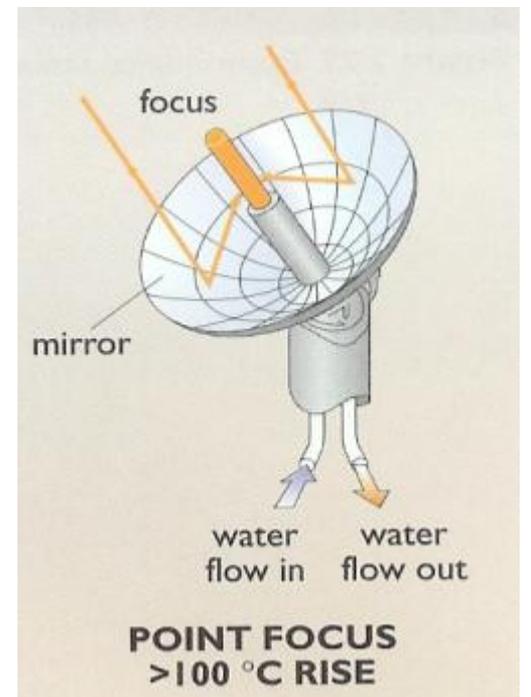
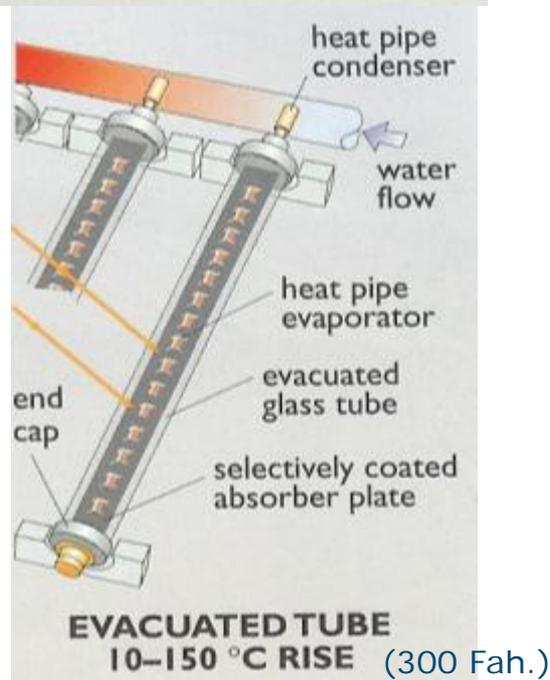
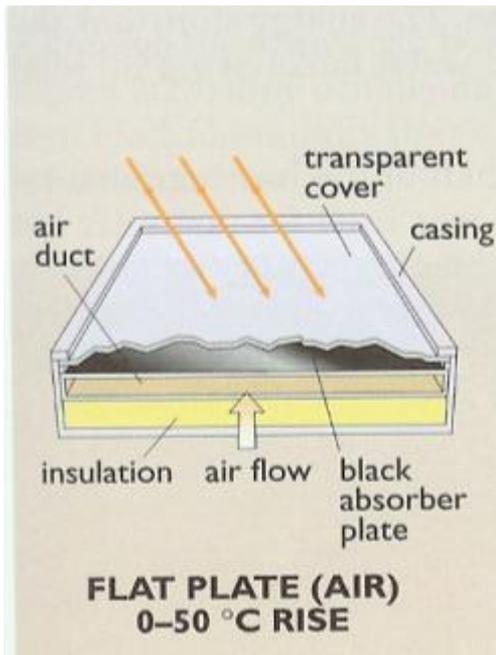
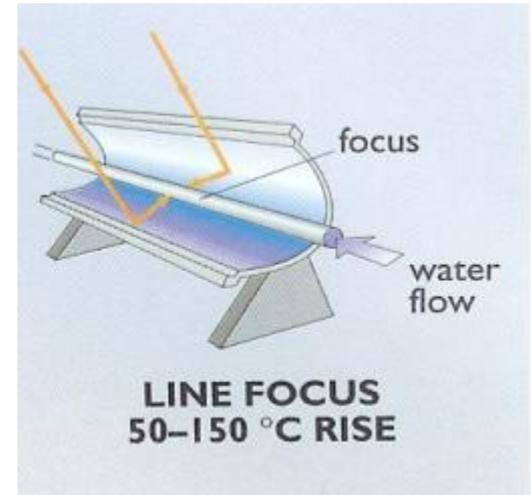
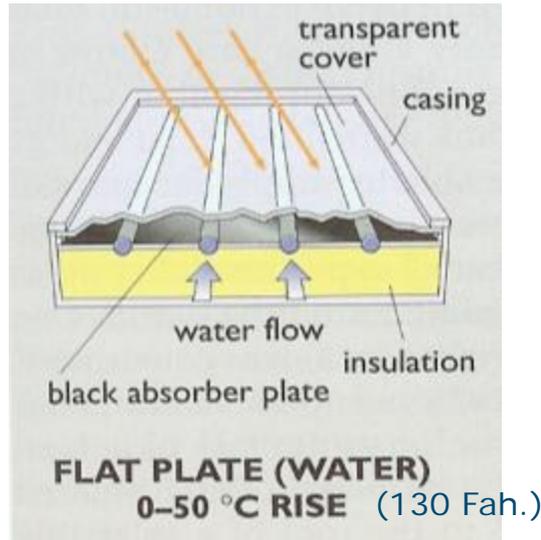
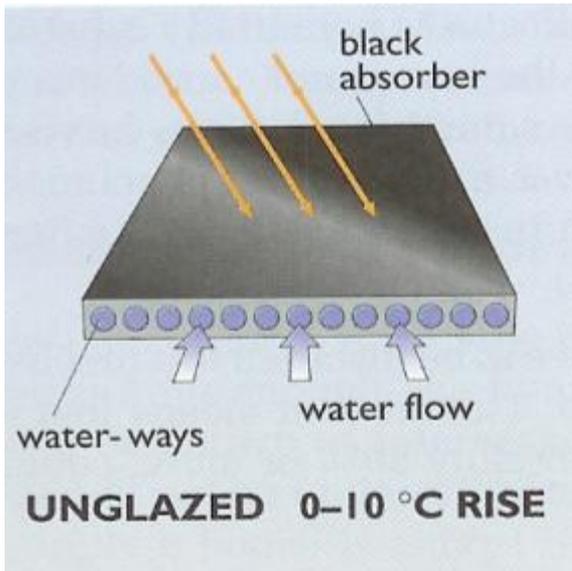
Boiler drains

All Safety Valves

- Shut off
- Temperature relief valve
- Pressure relief valve
- Vacuum relief valve
- Boiler drain
- Tempering valve



Types of Solar Collectors

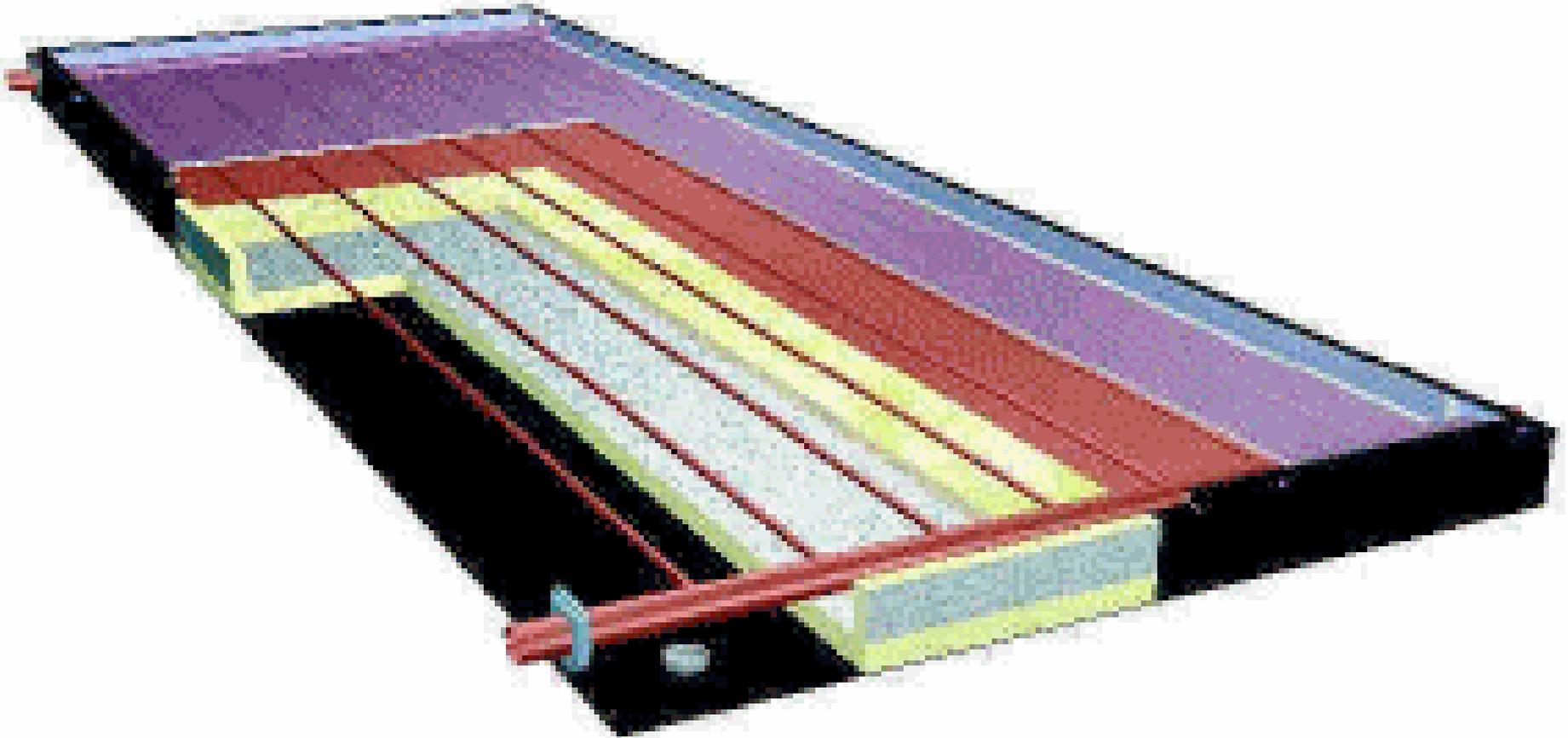


Parabolic Concentrator

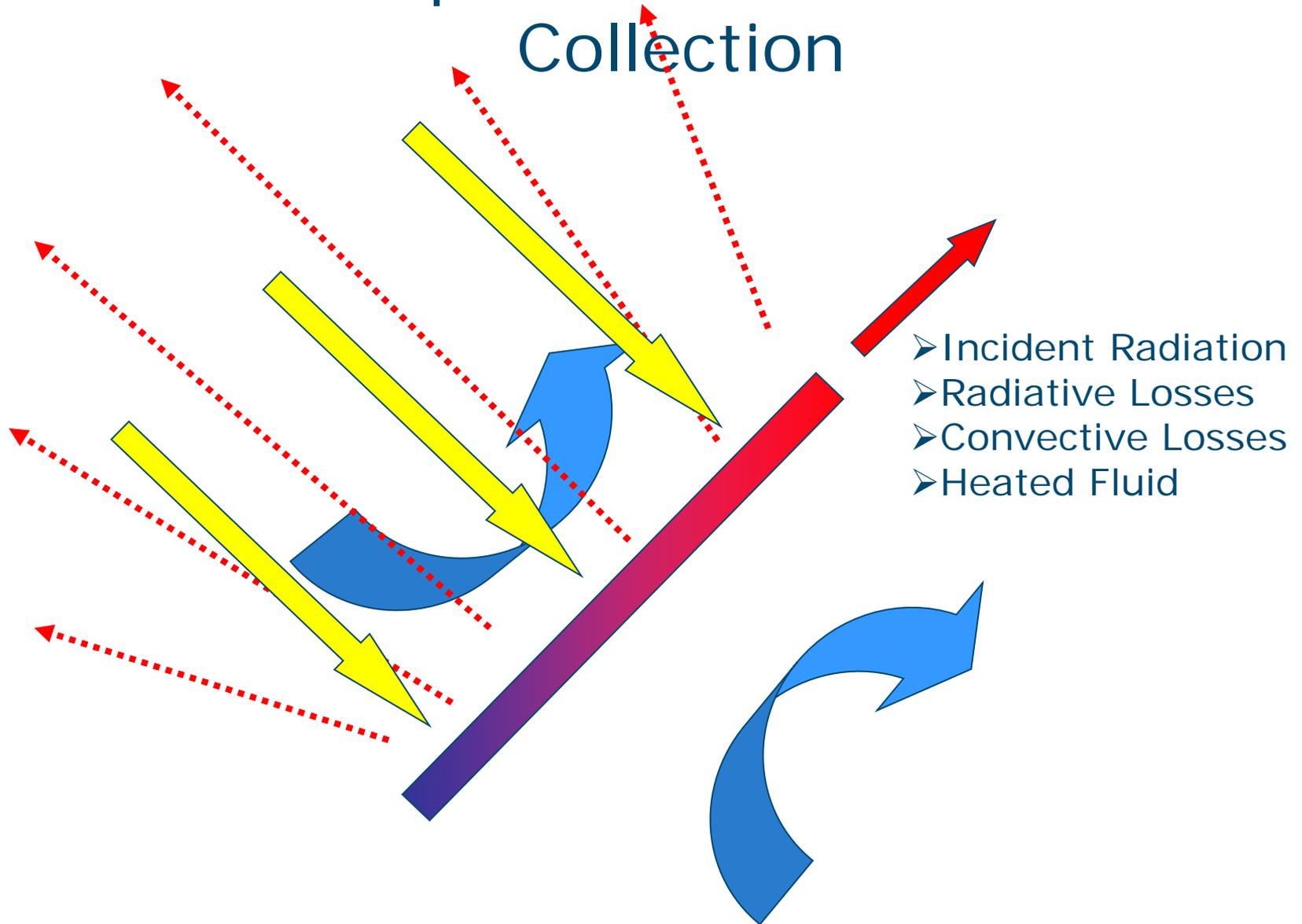


Flat Plate Collectors

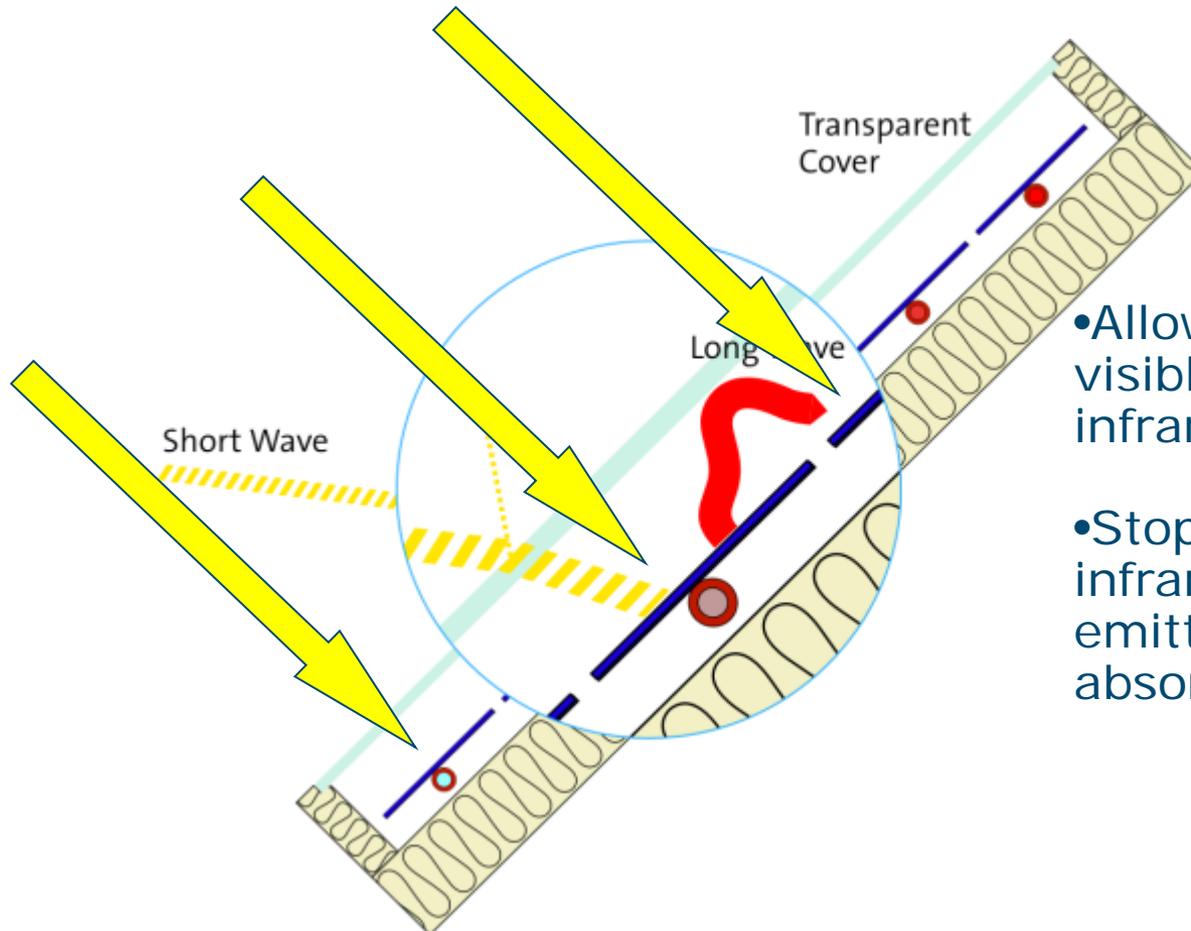
How they work



Principle of Solar Thermal Collection



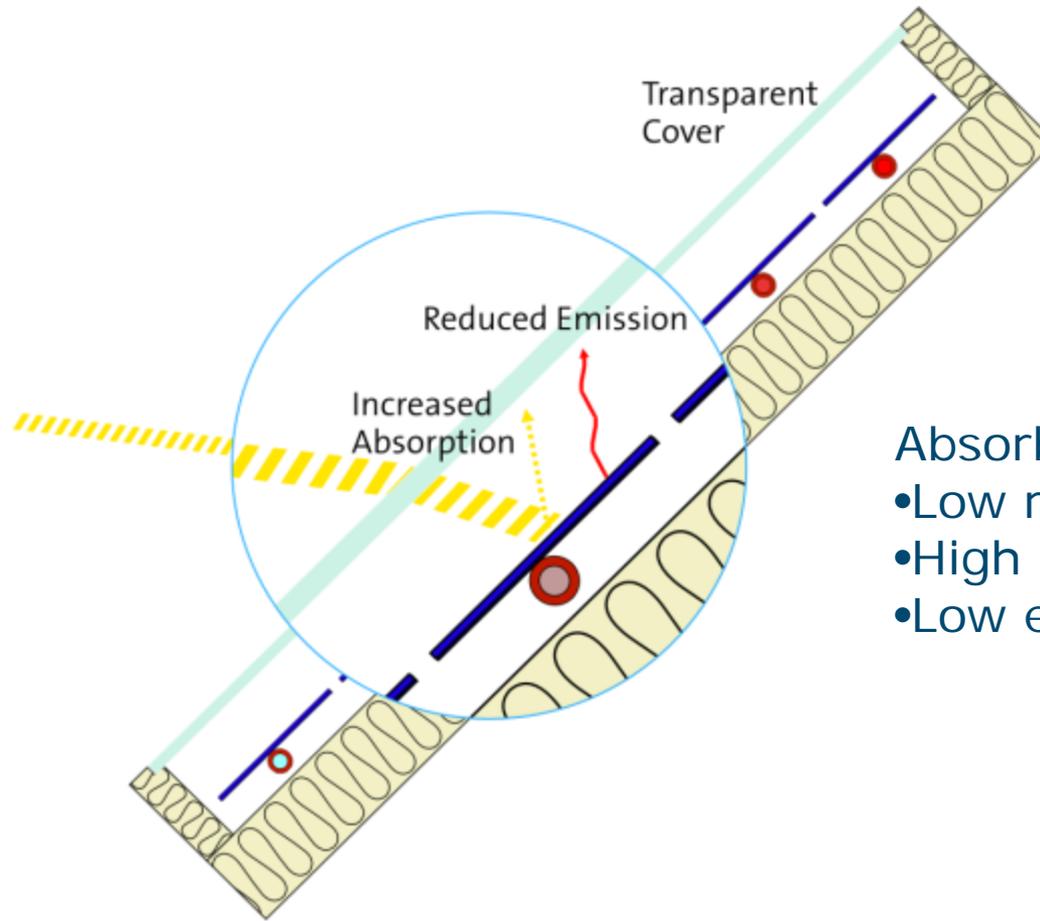
The Magic of Glass or Transmissive Selectivity (Greenhouse Effect)



- Allows the passage of visible short-wave infrared radiation

- Stops long-wave infrared re-radiation emitted from absorber plate

Absorption – Emission Selectivity



Absorbers should be:

- Low reflectance
- High absorption
- Low emission

Mounting Options

Ground Mounted Collectors



Mounting Options

Flush Mount



Awning



Saw
Tooth



Ground
Mount



And....

...the very popular...

Chicken Coop Mount



Sizing Closed Loop and Drainback Systems

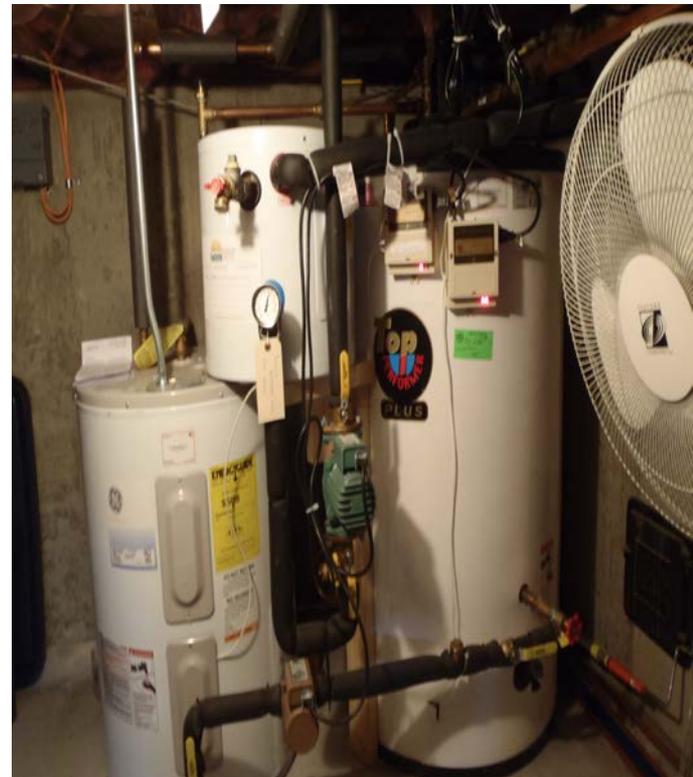
- Families of 4+ should have 75-96 sq. ft. of collector area with a 120 gallon tank
- Best results for storage versus collector area are 1.5 to 2 gallons per sq. foot of collector area.
- Mass. will not rebate systems with less than 1.25 to 1 sq. foot of area.
- Calculate HW usage at 20 gals. per adult, then 15 gals. ea. per other occupants



Wagner Segusol

Timer Myths and Cautions

- Little savings are achieved by putting timers on systems.
- In a 24 hour period, an electric element is only on seven times for a total of around three hours.
- Turning off the water heater of 8+ hours saves only pennies.
- Legionella bacteria in any part of the tank where the temp. is 100 deg. F



Legionella

- Legionella bacteria happens naturally in the environment.
- Thrives at temps. Between 95 and 115 deg. F
- Killed in two hours @122 deg. Fahrenheit.
- Killed in two minutes at 140 deg. Fahrenheit.
- Dormant but viable in cold water
- Read "*Legionella 2003, An Update by the Assoc. of Water Technologies*" (AWT)



Backup



Combination
(all in one)
Solar Tank



On Demand
Water Heater

...and any other
conventional water
heaters



Single and
Double
Coiled Tanks

Energy Savings

Domestic Hot Water:

- Typically the most applicable / best use for solar thermal
- Quickest payback of any renewable energy system
 - Always had better ROI than most stocks
- Lifecycle cost is cheaper than any other option
- DHW is 15-35% of typical household energy use
- Solar easily provides 60-90% of DHW demand
 - 100% of needs in summer
 - Backup typically necessary in winter



Two methods of solar energy production:

Thermal - up to 80% efficiency

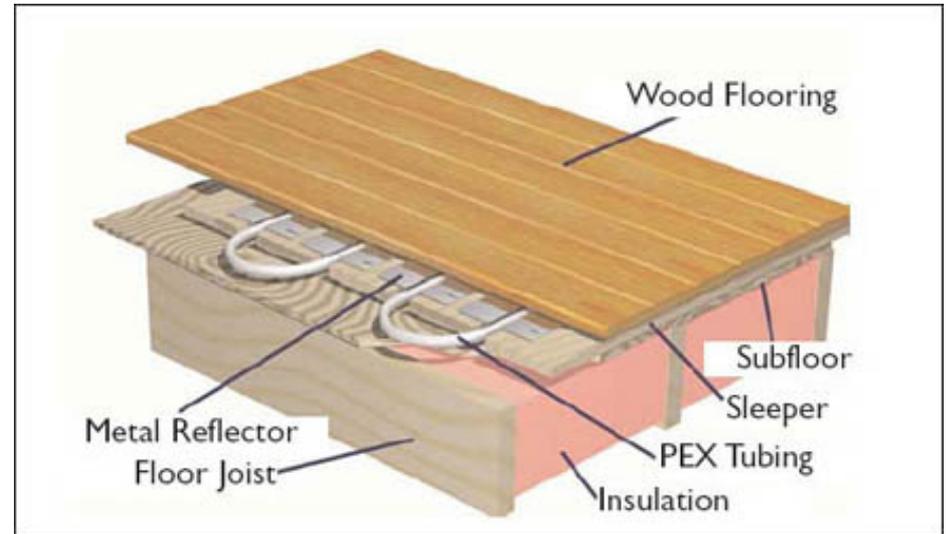
- ⊗ SDHW
- ⊗ Pool
- ⊗ Space heating/cooling

Photovoltaic –up to 15% efficiency



Space Heating

- Solar Thermal can be used for space heating, but resource is out of synch with demand.
- Works best with radiant floors which require lower water temperatures, but can be integrated with other systems (except electricity).
- Space heating systems require larger systems (bigger tanks, more panels).
- Solar Panels should be angled more vertically to optimize winter gain.
- Increasing angle to 60 or 65 deg. can improve energy production by 15-20%.
- Excessive heat from lower angles takes its toll on components in summer.



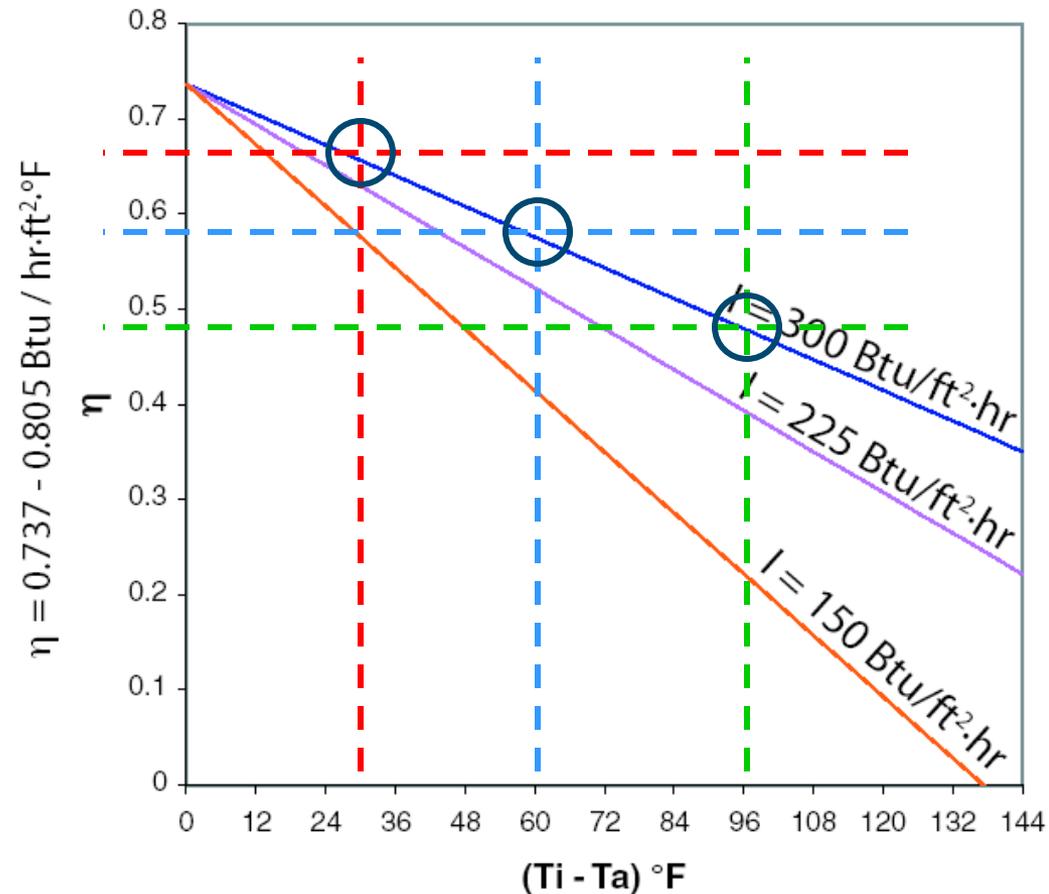
THERMAL COLLECTOR EFFICIENCY

Examples

90° F fluid
60° outdoors
~66% efficient

120° F fluid
60° outdoors
~58% efficient

156° F fluid
60° outdoors
~48% efficient



Collector Data as part of OG-100 testing

<p>SOLAR COLLECTOR CERTIFICATION AND RATING</p>  <p>SRCC OG-100</p>	<p><u>CERTIFIED SOLAR COLLECTOR</u></p> <p>SUPPLIER: SunEarth, Inc. 8425 Almeria Avenue Fontana, CA 92335 USA</p> <p>MODEL: Empire EC-40 COLLECTOR TYPE: Glazed Flat-Plate CERTIFICATION #: 100-2006-024E</p>
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COLLECTOR THERMAL PERFORMANCE RATING							
Megajoules Per Panel Per Day				Thousands of Btu Per Panel Per Day			
CATEGORY (Ti-Ta)	CLEAR DAY 23 MJ/m ² ·d	MILDLY CLOUDY 17 MJ/m ² ·d	CLOUDY DAY 11 MJ/m ² ·d	CATEGORY (Ti-Ta)	CLEAR DAY 2000 Btu/ft ² ·d	MILDLY CLOUDY 1500 Btu/ft ² ·d	CLOUDY DAY 1000 Btu/ft ² ·d
A (-5°C)	59	44	30	A (-9°F)	56	42	28
B (5°C)	54	40	25	B (9°F)	52	38	24
C (20°C)	47	32	18	C (36°F)	44	31	17
D (50°C)	30	17	5	D (90°F)	29	17	5
E (80°C)	14	4		E (144°F)	14	4	

A-Pool Heating (Warm Climate) B-Pool Heating (Cool Climate) C-Water Heating (Warm Climate) D-Water Heating (Cool Climate) E-Air Conditioning

Some Do's and Don'ts in Solar Thermal Installations



Roof Penetrations

Do: flash around pipe and not around insulation



Don't



Do: use Cooley Cap or other flashing that fits tightly around pipe.

DO: Insulate all hot water lines



Do



Don't

DO: Tag valves and Components on complex systems



Do

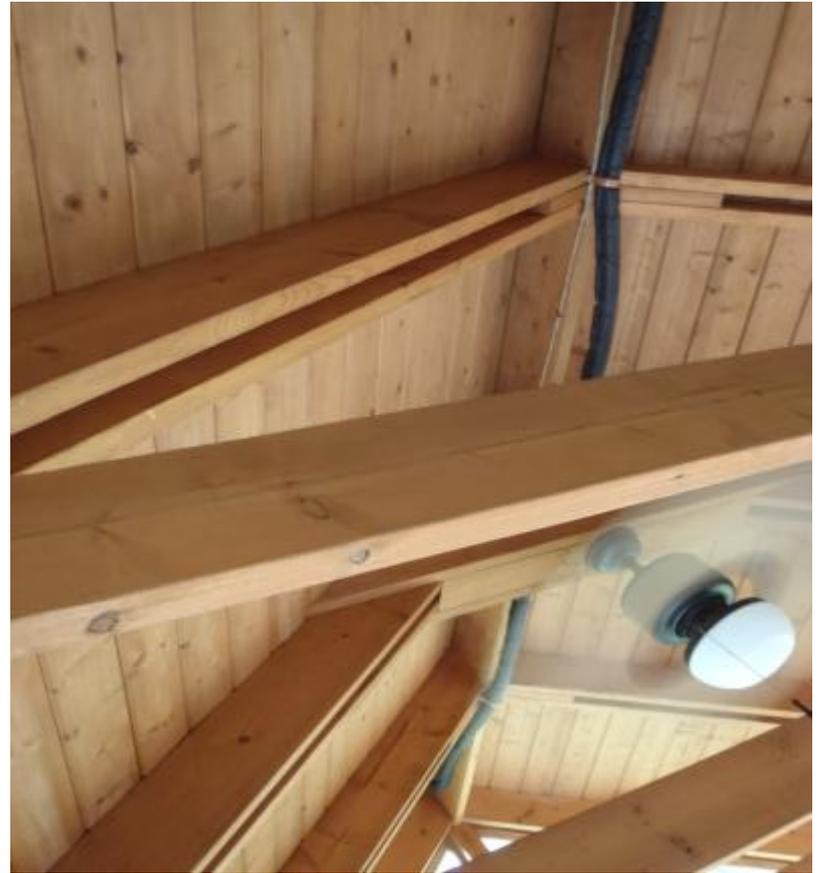


Don't

DO: Esthetically pleasing work



Pipe Cover System

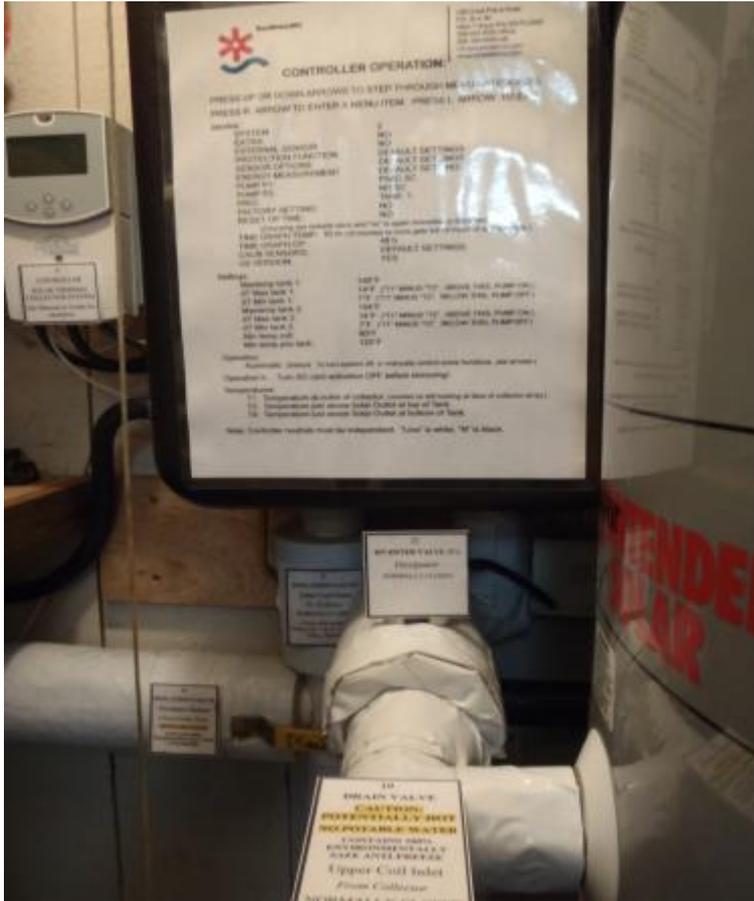


Pipe strung in living area

DO: Use appropriate blocking



DO: Educate the customer and leave information to keep them well informed.



Laminated Instructions



Three-ringed binder

DO: Use appropriate piping material and safety valves.



Lacks vacuum relief valve



Improper materials

DO: Plan location of heat dump.



DO: Plan piping configuration.



Pipe configuration allowed for hot/cold cross connection. Check valve or re-configuration necessary.

Don't: Clamp to metal roof.



Each of these clamps could be required to hold 800 lbs. of uplift - and they could – but the wood screws and washers that hold this raised seam metal roof won't.

Consider Data Monitoring

- Ensure system production and normal operation
- Notification of system issues
- Informed SHW design
- Build customer relationships
- Marketing opportunities
- Piece of mind for customer

We use:

- Sun Reports
- Resol (DL 3 only)
- Heliodyne
- Locus
- SolarTron





END



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