

Residential Solar Thermal Systems



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Objectives

Basics of solar DHW for cold climates:

- What kind of equipment?
- How do the systems work?
- How much energy do they collect?

Icing on the Cake



Collectors

Flat Plate

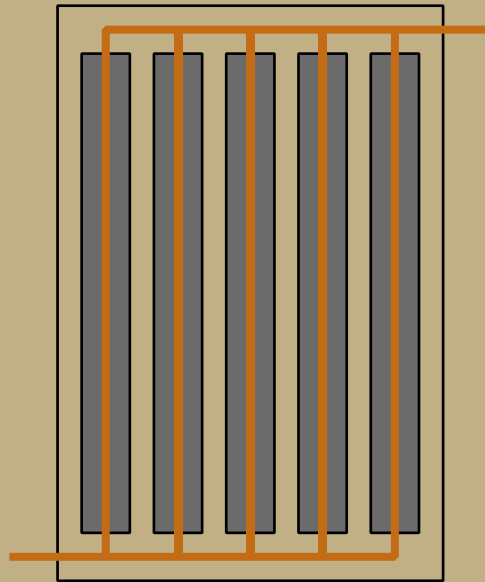


Evacuated Tube

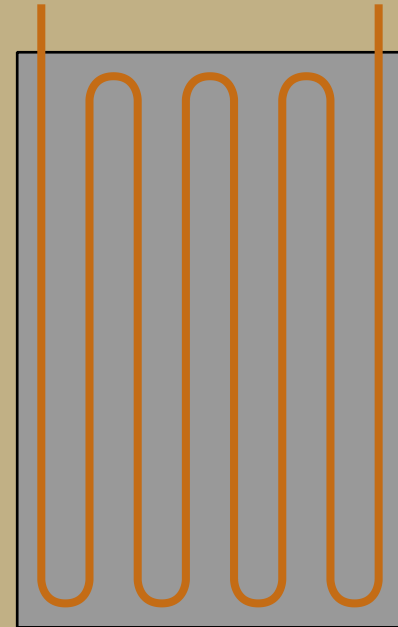


Flat Plate Designs

Two major Flat-Plate types:

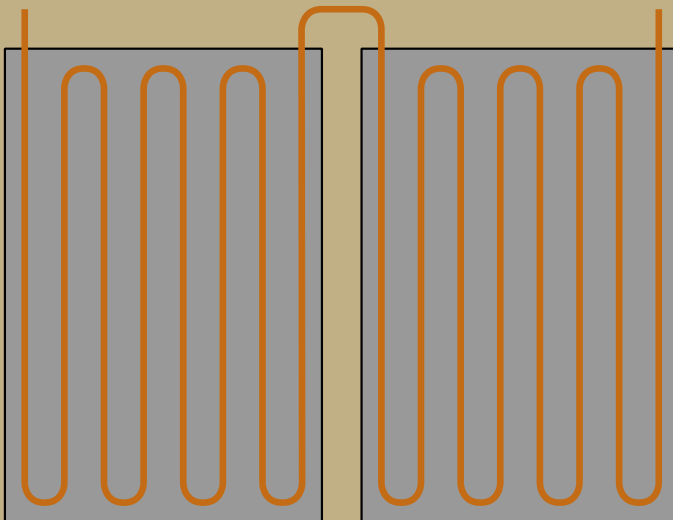
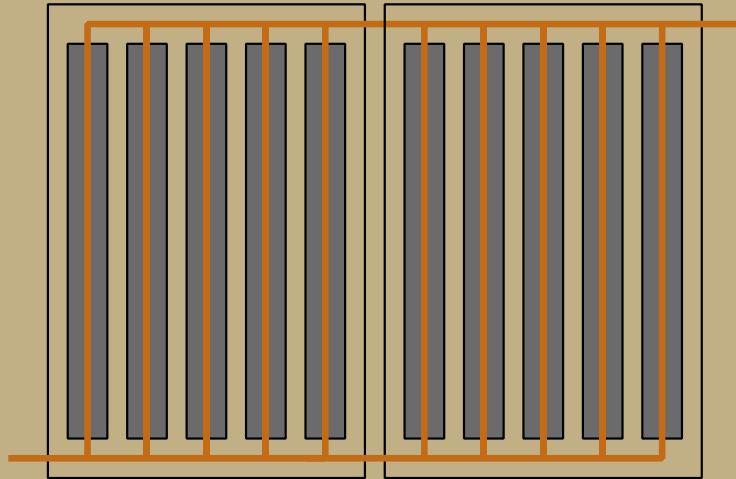


Parallel
Manifold (Harp)



Serpentine

Flat Plate Collectors



Evacuated Tubes



Collectors

Flat Plate



Pro's

- Lower cost (often)

Con's

- Heavy
- Less output in low temps and low light*

Evacuated Tube



Pro's

- Higher temperature
- Better generation in low temps and low light*

Con's

- Higher temperature (summer)
- Higher cost (sometimes)
- Snow shedding

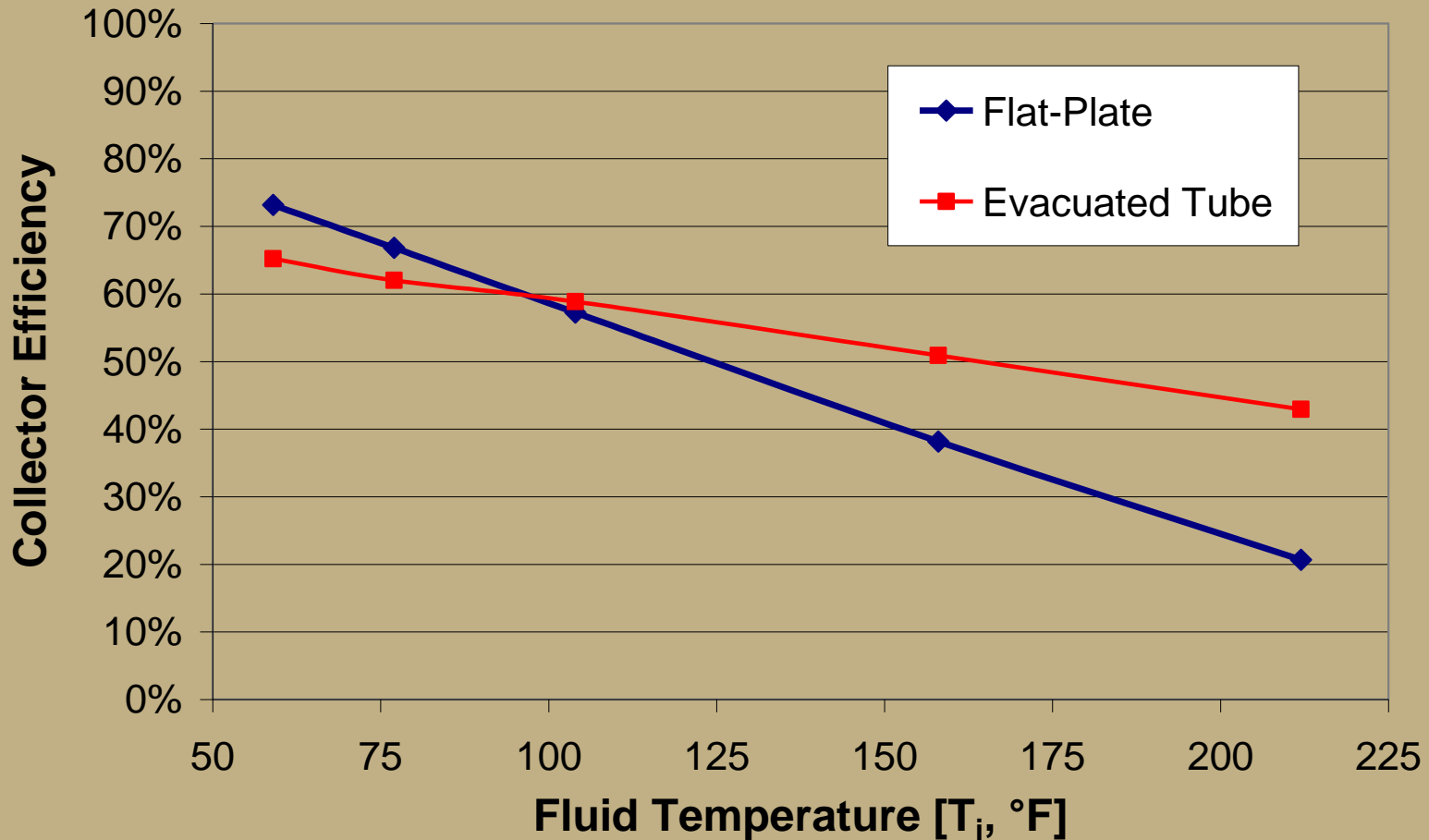
Evacuated Tubes and Snow



Flat Plate vs. Evacuated Tube

Flat Plate vs. Evacuated Tube Efficiency

68°F Ambient Temperature, Clear Day



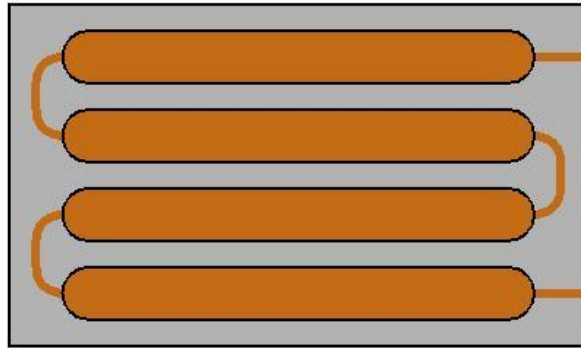
Heat Storage

- Water tanks
- Typically 1.5 – 2 gal/ft² of solar collector area
- Insulate tanks well (e.g. added tank wraps)
- Locate tanks close to collectors AND auxiliary heaters

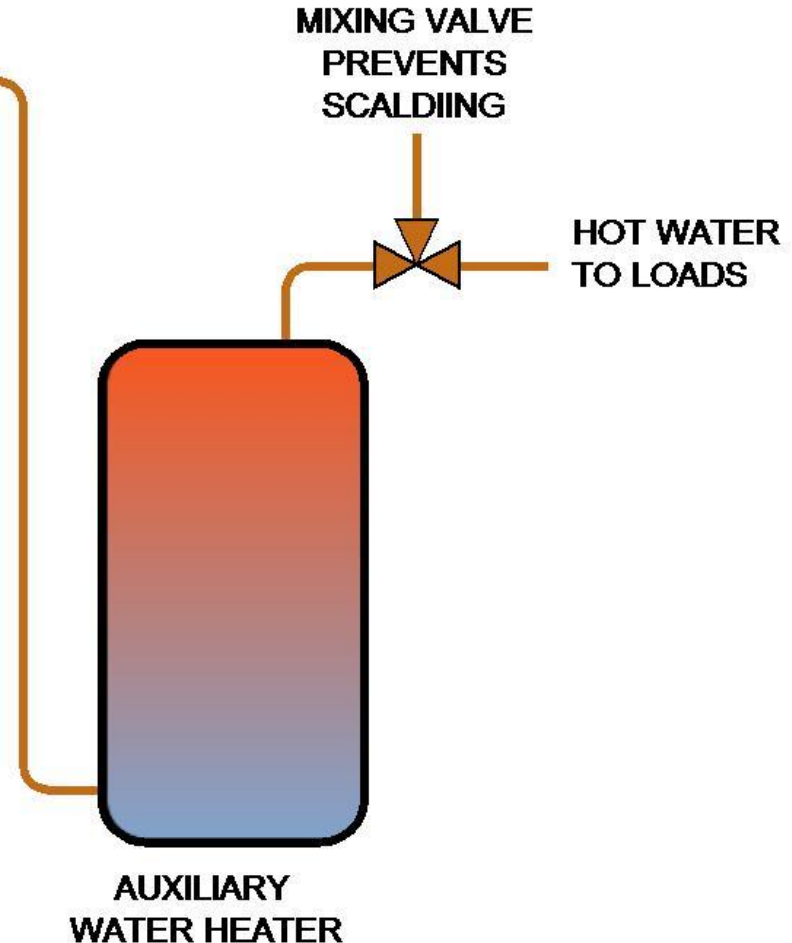


ICS: Direct, Warm-Climate System

ICS - INTEGRATED COLLECTOR & STORAGE



COLD WATER IN



ICS

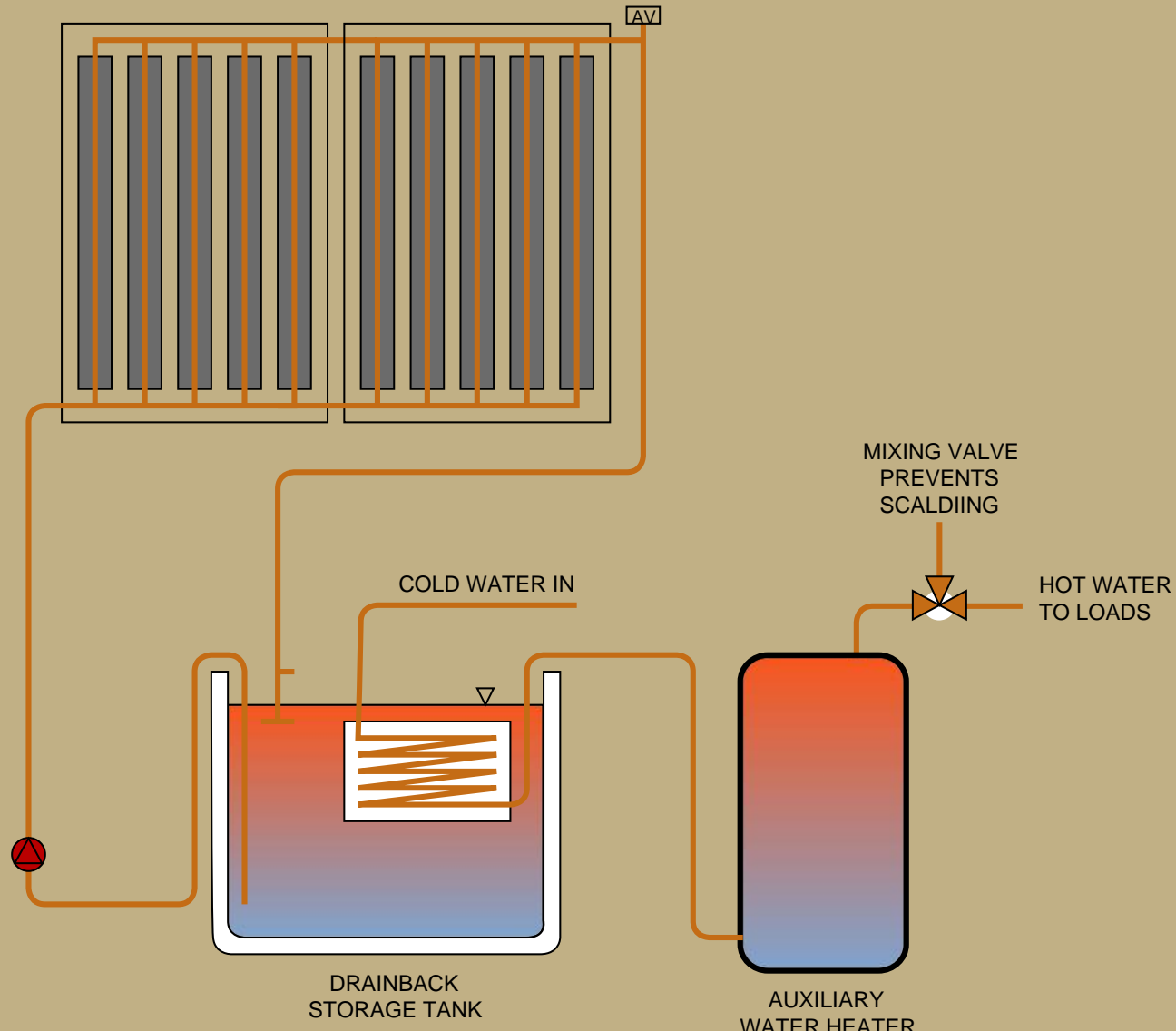


Freeze-Protection Strategies

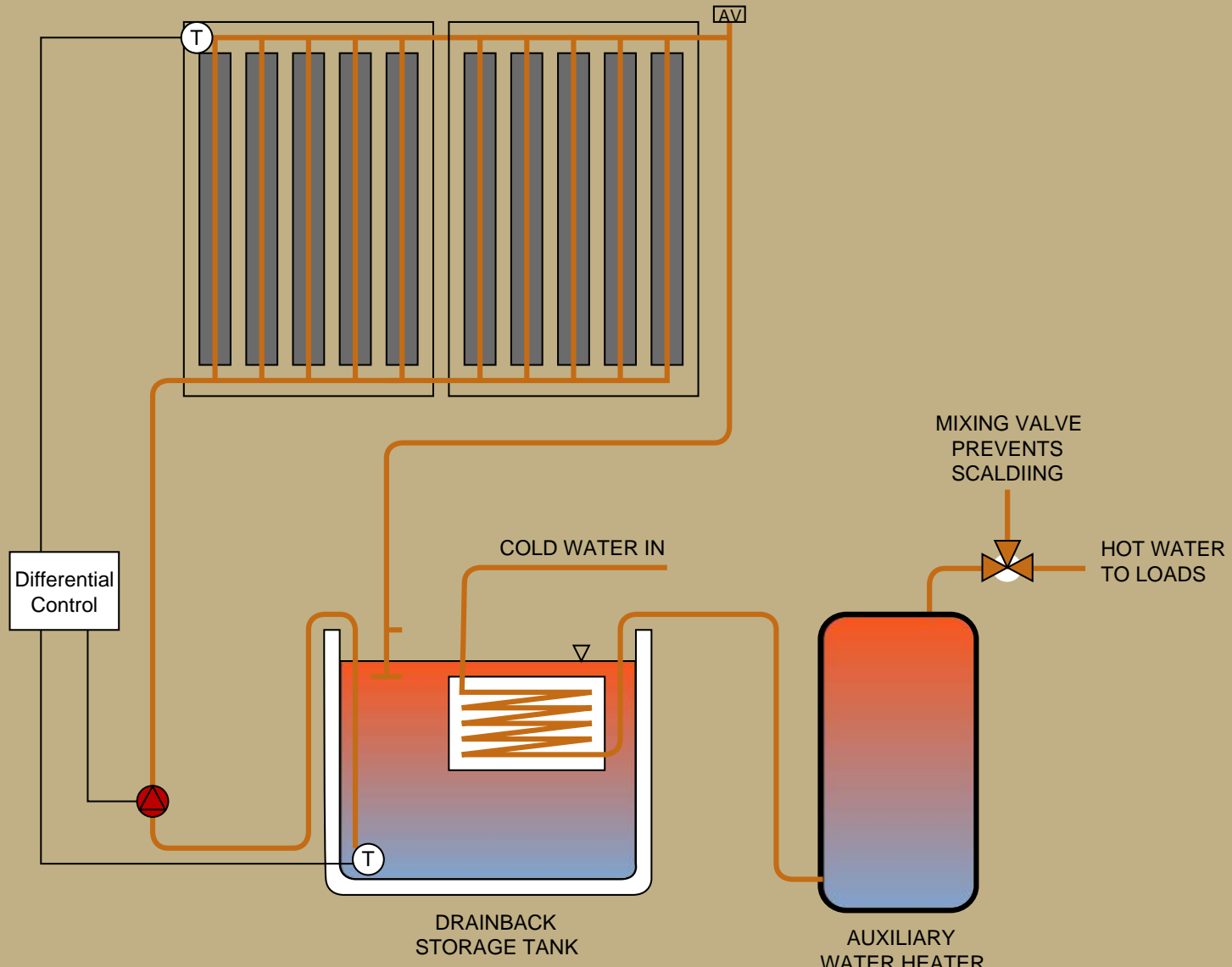
Two Main Strategies:

- Drainback
- Closed-loop with antifreeze

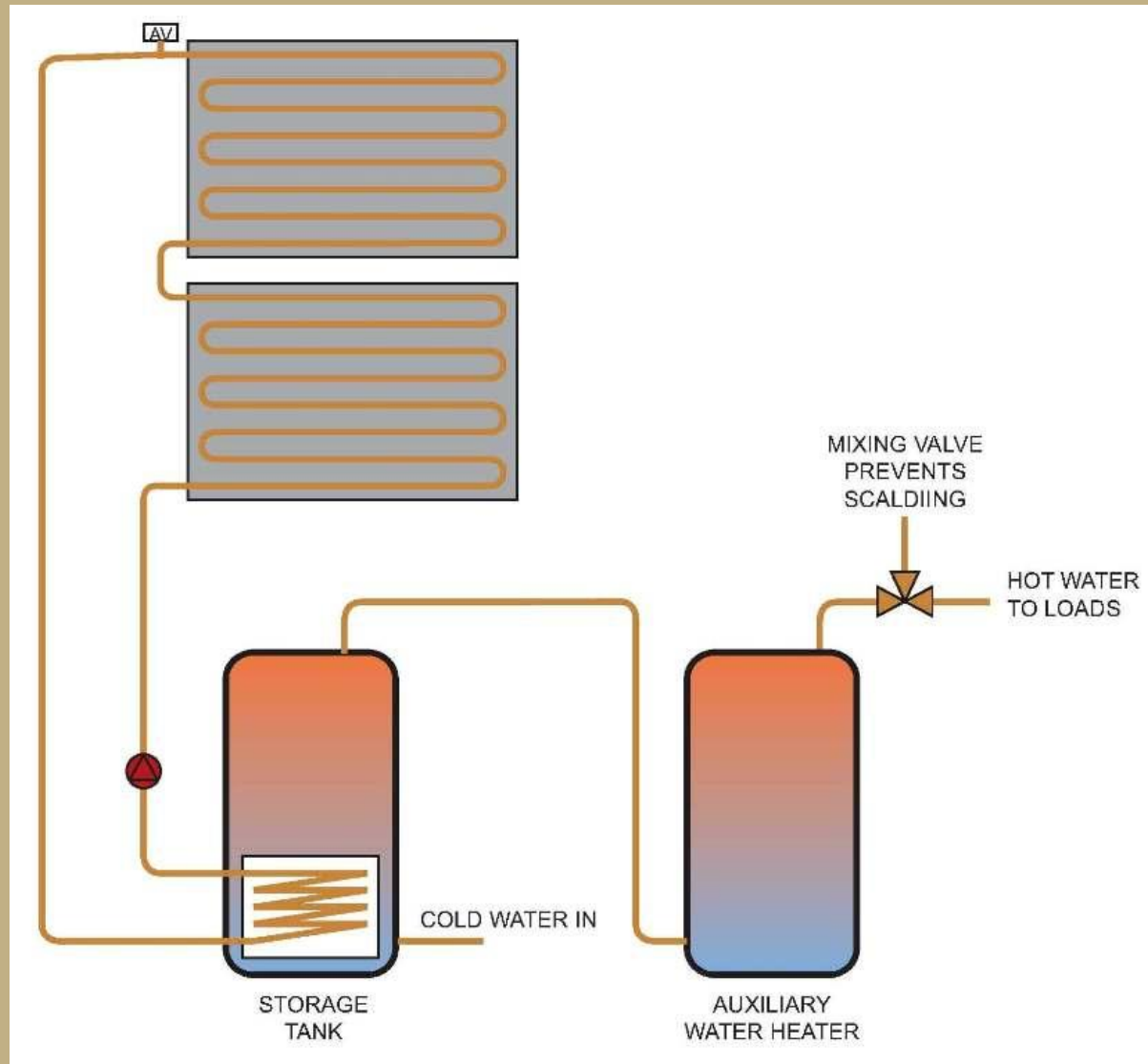
Drainback



Drainback Control



Closed Loop, Antifreeze



Freeze-Protection Strategies

Drainback

Pro's

- Possibly lower maintenance (no replacing antifreeze)
- Good overheating protection

Con's

- Larger circulators
- Plumbing slopes critical
- No serpentine collectors

Antifreeze

Pro's

- Versatile plumbing runs
- Smaller pumps (PV-powered possible)
- Serpentine or parallel manifold collectors

Con's

- Glycol must be maintained
- High temperature protection needed

Solar Thermal Certifications



SOLAR RATING AND CERTIFICATION CORPORATION

Independent Certification of Solar Water and
Swimming Pool Heating Collectors and Systems

<http://www.solar-rating.org/>

SRCC OGC-100, collector certification

SRCC OGC-300, system certification

Section 6: Certification Criteria

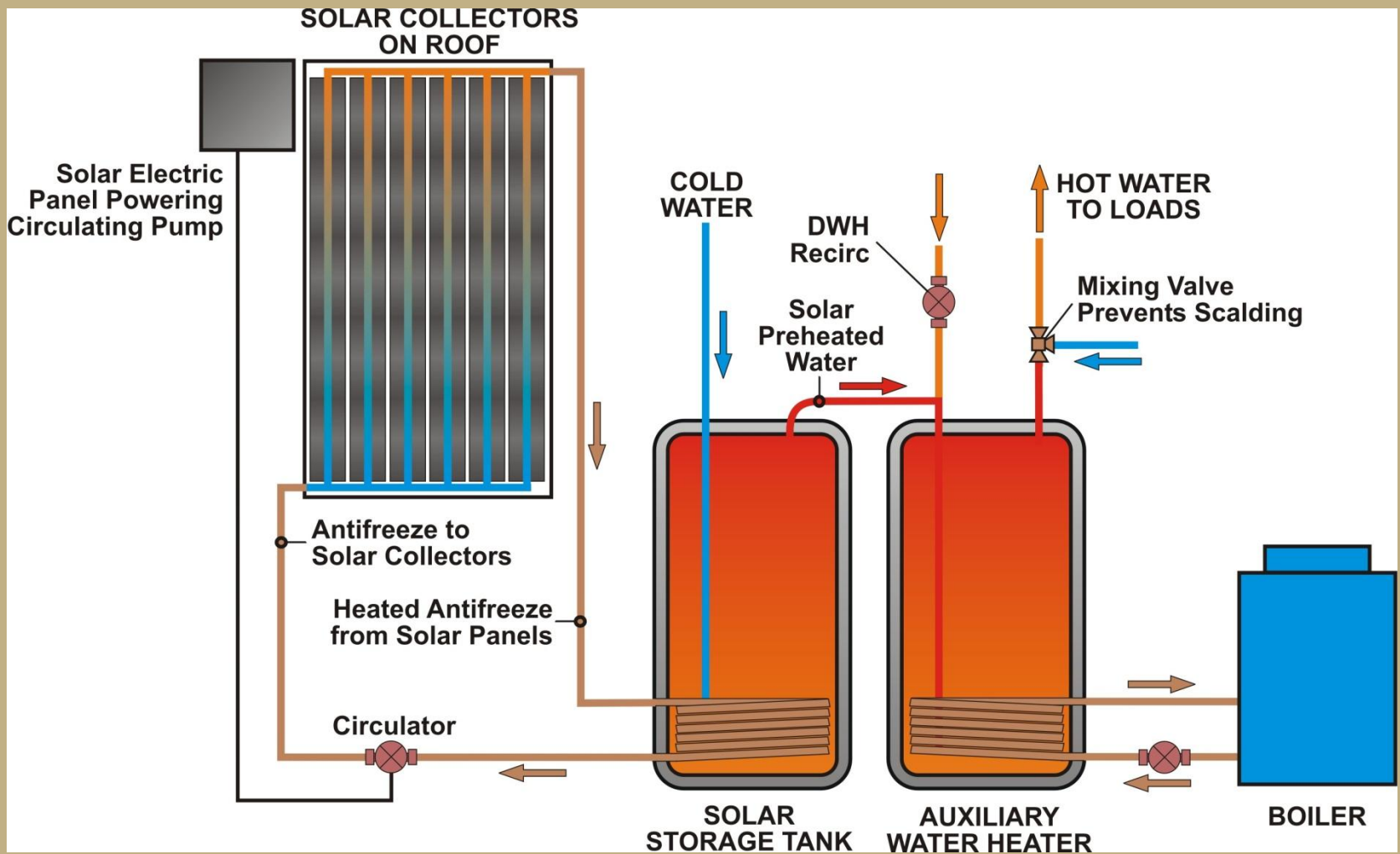
Monitored Systems

Hadley, MA



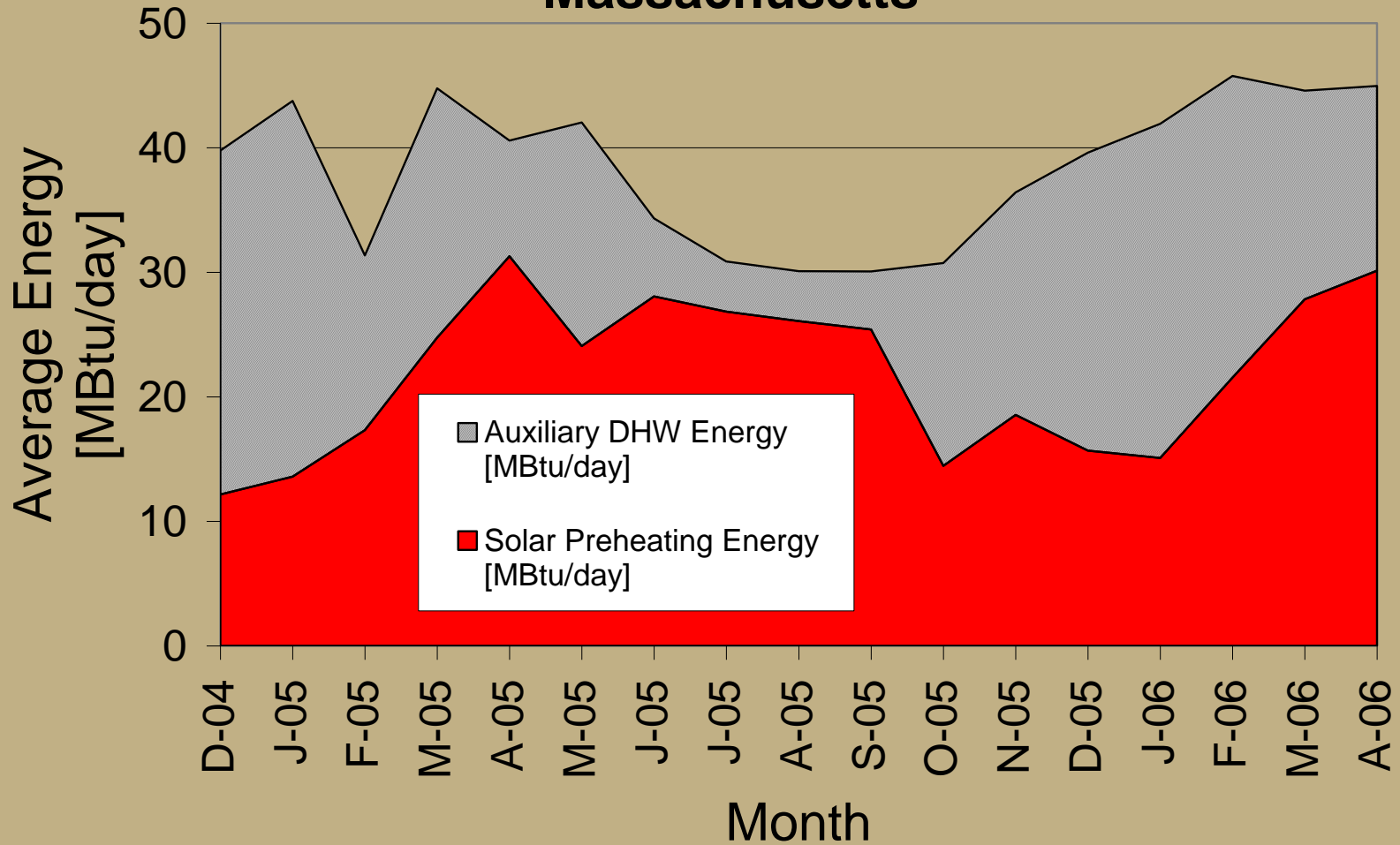
- Two, 32-ft² flat-plate collectors
- Closed-loop, 50% propylene glycol
- 80-gallon storage tank
- Separate auxiliary heater

Mass. System Schematic



Massachusetts Performance

Domestic Hot Water Energy Massachusetts



Performance

Overall
Hot Water Use: 64 gal/day
Annual Solar Fraction: 61%

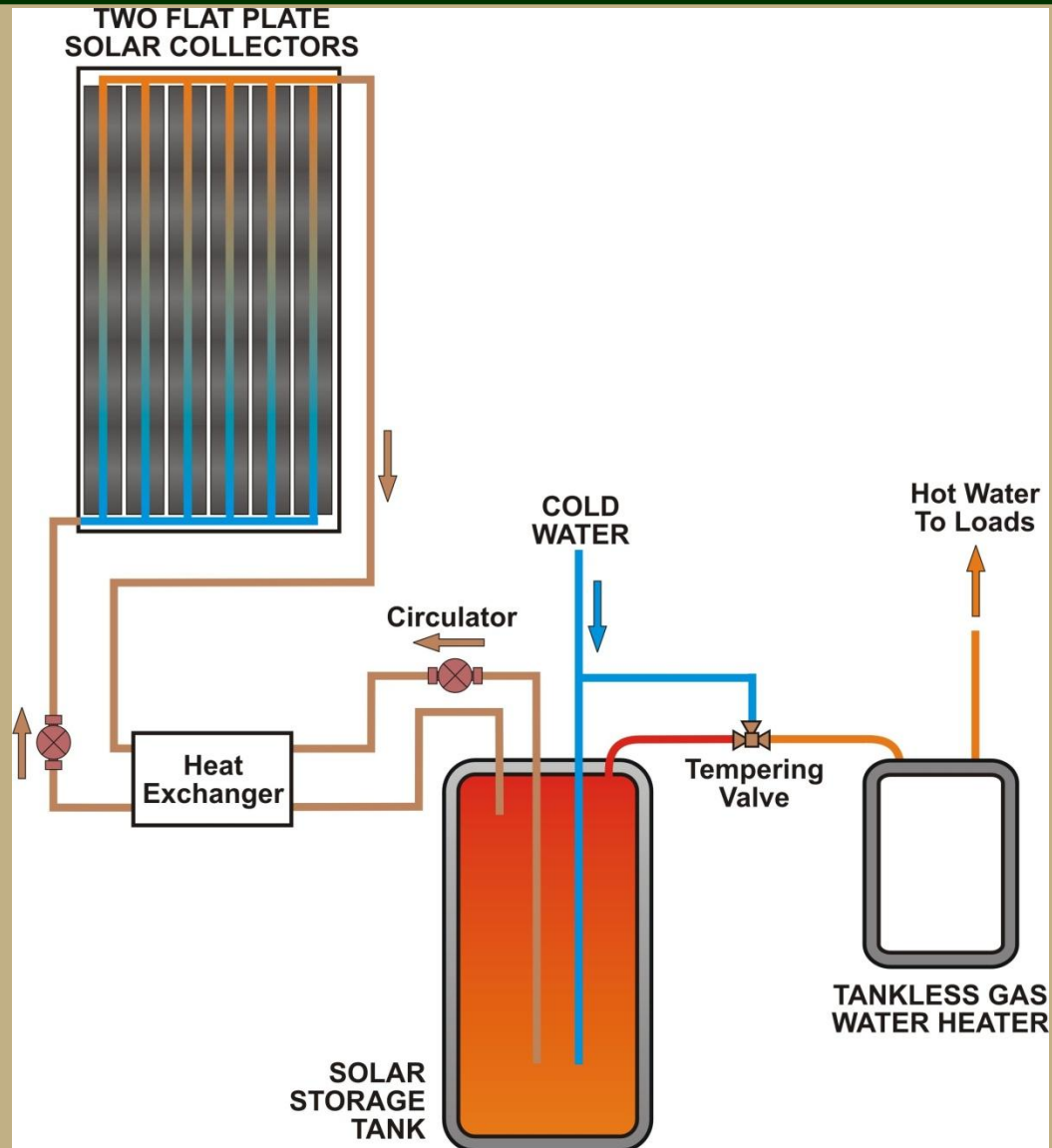
Monitored Systems

- Two, 32-ft² flat-plate collectors
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Madison, WI

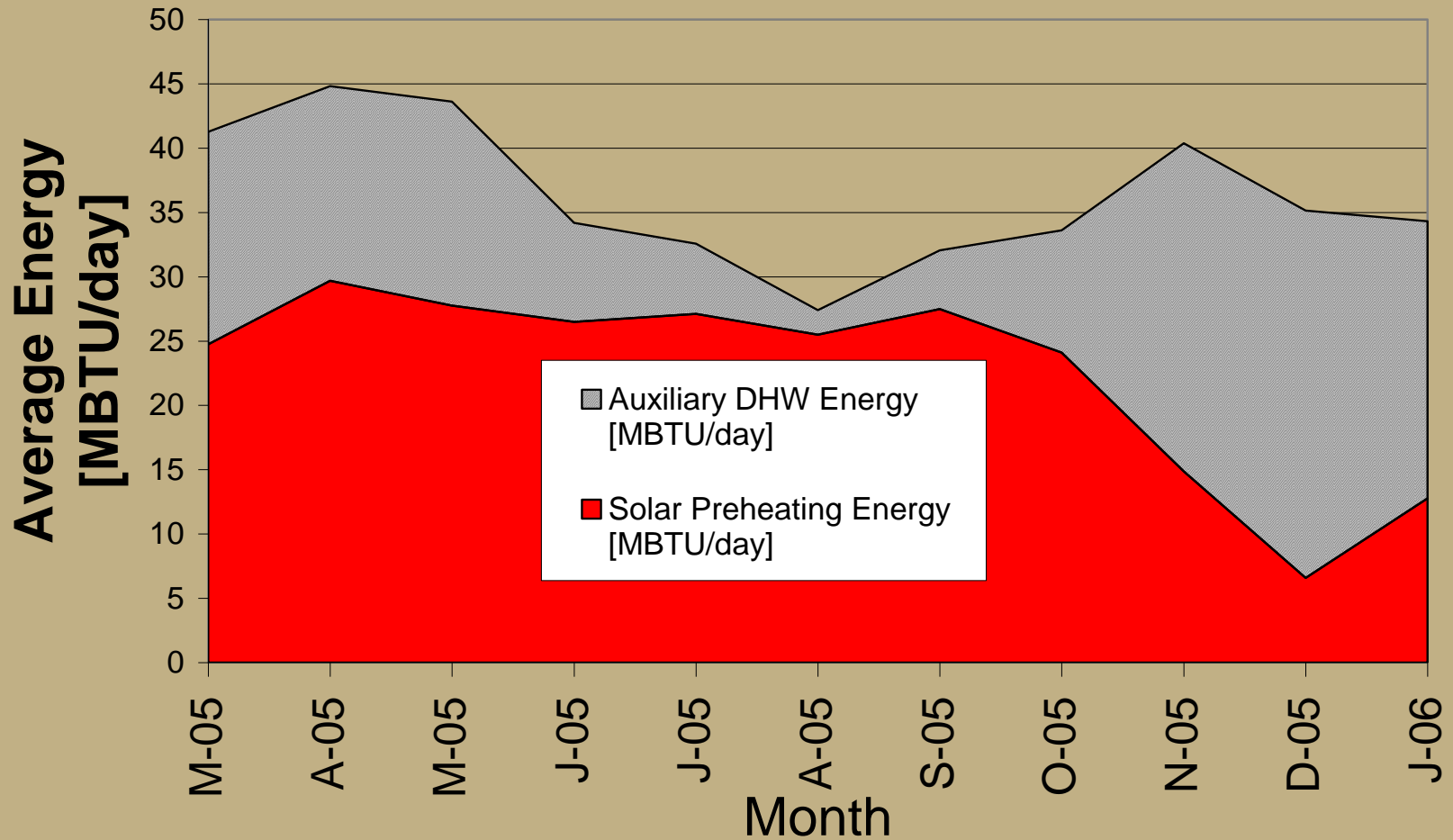


Tankless WH Integration



Wisconsin Performance

Domestic Hot Water Energy Wisconsin



Performance

Overall

Hot Water Use: 71 gal/day

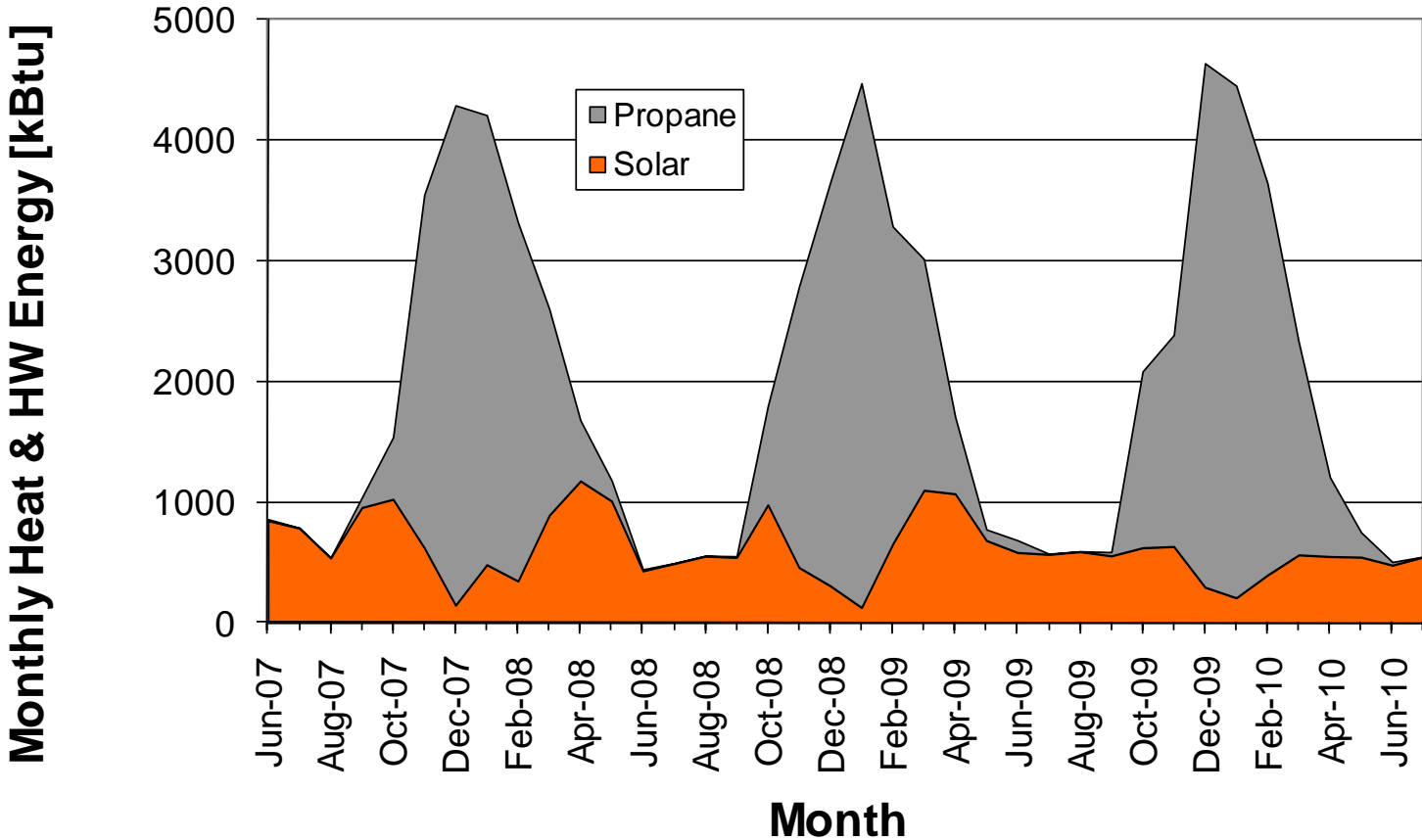
Annual Solar Fraction: 63%

RDI Home – Colrain, MA



RDI Home – Colrain, MA

RDI Colrain Home: Space and Water Heating Energy



Solar DHW: Cost

Typical cost of solar DHW system on single-family homes:

\$9,000 - \$15,000

Generally:

- Cost-effective with expensive water heating (e.g. elec. resistance)
- Not cost-effective with very efficient water heaters (e.g. gas tankless, eff. indirect)

SDHW Recommended Spec's

For SF Homes:

- Work with contractors
- Comply with SRCC OG-300 Chapter 6 requirements (not necessarily OG-300 certified)
- Approx. 60-80ft² of flat-plate collector (or maybe less evacuated tube)
- Approx. 80-120 gallons storage
- Pipe runs minimized; insulate pipes to at LEAST R-4 (more recommended)
- High temperature protection (heat dumps or other for glycol systems)
- Clear manual for operation and maintenance
- **Commission the system!**

Thank You!

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