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Installation Workshop

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Slide presentation courtesy of Enerworks

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Welcome to the Smart Solar Seminar

Our Smart Solar manufacturing partner is EnerWorks from Ontario, Canada

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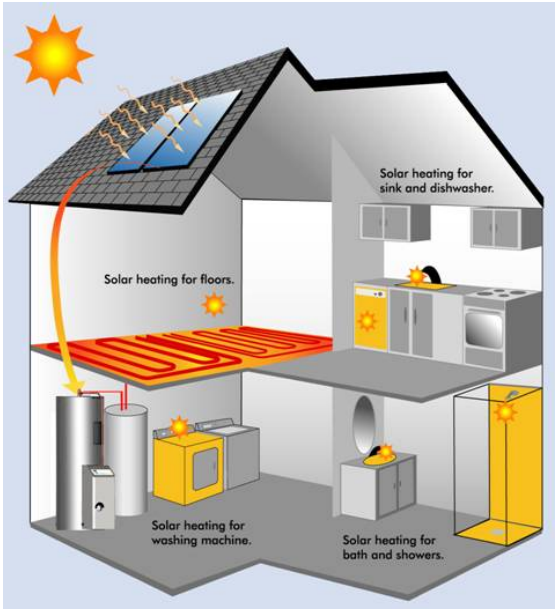
Agenda



- Introduction
- Competitive Landscape
- SolSim – savings simulation software
- Selection, Sizing and Site Evaluation
- Solar Collector Installation
- Appliance (tank & Energy Pack) Installation
- Controller and Remote Monitor
- Summary, Warranty and Incentives
- Commercial Project overview
- Solar Quiz

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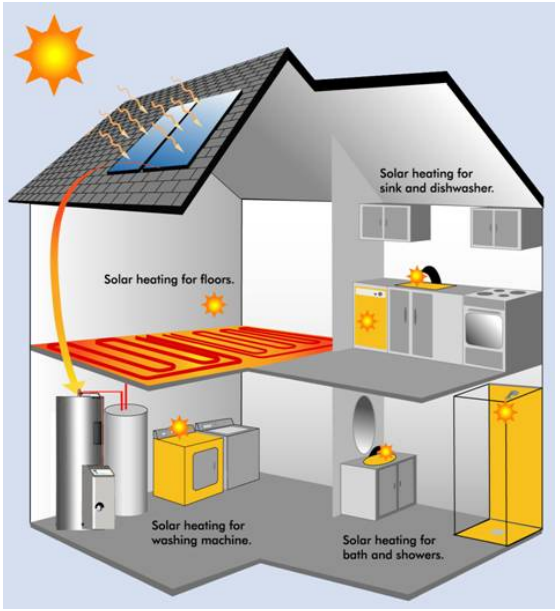
Reminder



Each purchase of a Smart Solar System or System 2000 within the next two months qualifies for one seminar credit.

Be sure to tell us when you order so we can process your credit.

Thank you!

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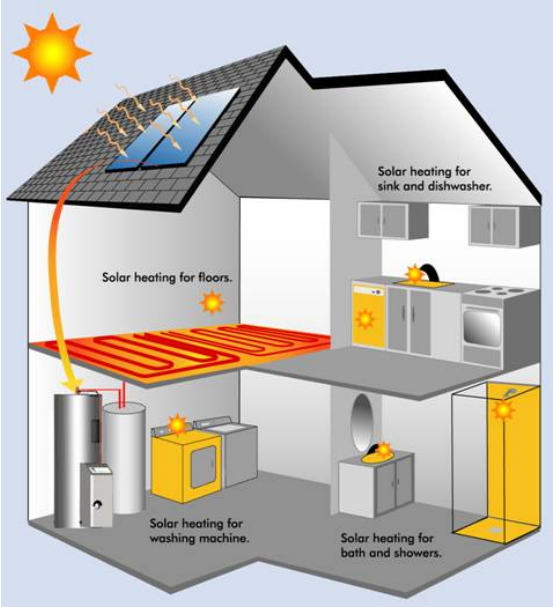

Introduction

- Benefits of Solar Thermal
- **EnerWorks** – our manufacturing partner
- Solar Technologies

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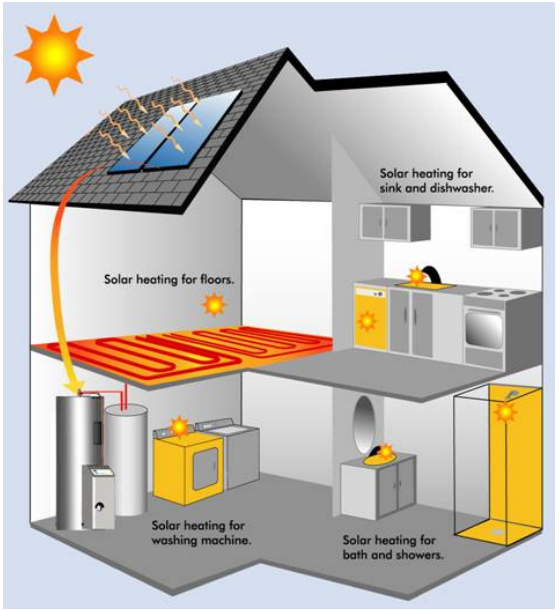

Benefits of solar thermal

- Single source Energy Expert
- Renewed Focus & Tax Credits
- Highly searched and lead potential
- In home solutions expand to System 2000
- Consistent with energy efficiency as a “First Fuel”, followed by renewable energy
- Produce about 60% of hot water from sunshine
- Other ideas?

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Our Manufacturing Partner

EnerWorks

- Top rated performance
- North American manufacturer
- Plate Exchanger Counterflow efficiency
- Tank thermal stratification design
- Solid integration with System 2000
- Very complete installation kit
- 3/8” Linesets and quick connectors
- Single pump and thermosiphon (simplified install) Solar panels look like skylights
- Competitive costs, faster installation than other systems

Module # 1

Competitive Landscape

Follow along with this module and page number in your training binder

Module 1

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Introducing EnerWorks

Vision:	• To be the dominant North American vendor of integrated commercial and residential solar thermal (ST) systems
Location:	• Dorchester, Ontario
Products:	• Residential and Commercial ST appliances and collectors
Funding:	•Only venture backed solar thermal company in N.A. • Investors include: Chrysalix Energy, Investeco Capital, Covington Venture Fund, Venture Link Funds
IP:	• 2 patents granted • potential IP in collector assembly & manifold technology
Differentiation:	• only solar thermal company to focus on HVAC, new home and renewable channels with turnkey resid/commercial appliance. • Organized to support distributor to dealer channel model • Ability to scale and support large channel partners •Only solar thermal company in N.A to be SRCC and CSA certified

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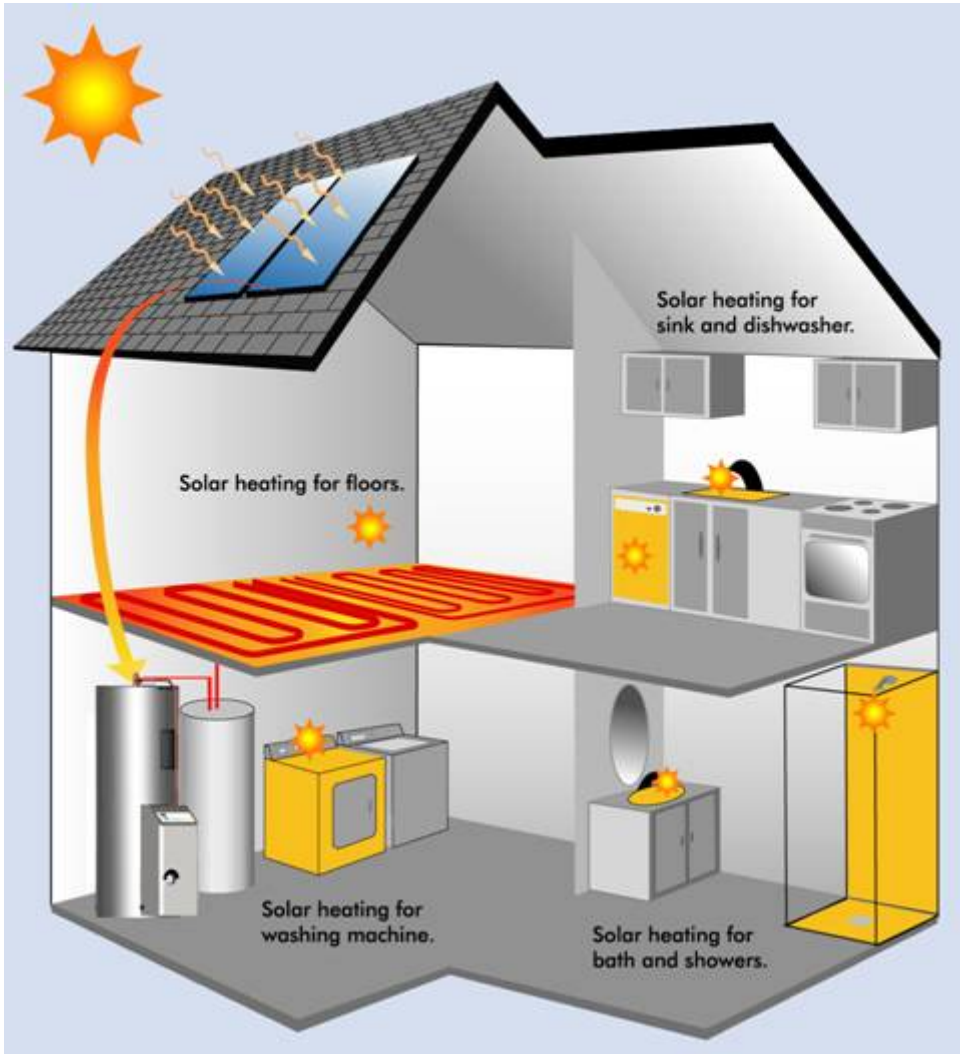
Bringing Solar Thermal Mainstream



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Manufacturing: Dorchester, Ontario – Built to scale through automation and assembly strategy

- EW Capacity: 80,000 m^2 per year
- 2005 Total US Production: 6,500 m^2 (US figures for med temp domestic and export ST production 2005)
- Over 10,000 panels in service by 2008

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Current Business Overview

- EnerWorks product is proven
  - 1,000's of successful installations
    - ~ 8 megawatts (peak power)
  - Product in the field for 5 years
  - Best product offering (appliance)
  - Engineering excellence

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Key Players

- Phil Whiting – President & CEO
- Tony Ali – VP Sales
- Florin Plavosin – Director Engineering
- Dr. Lucio Mesquita – Sr. Engineer
- Rob Singlehurst - Engineer
- Wilf Laman – Director Bus. Dev
- Kathleen Barnard – Marketing Mgr
- Rick Huber – Director Operations
- Jay Raes – Training Leader
- Terry Chalmers – Sourcing Manager
- Andrew Mauchlen – R&D Manager

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The EW Team

- Sr. Management Team
  - Phil Whiting – President & CEO
    - 25 yrs technology commercialization,
  - Tony Ali – VP Sales & Customer Allegiance
    - 20 yrs sales and operations
  - Lester Holley – VP Finance
    - 20 yrs finance
  - Steve Harrison – Queens U - Professor
    - 30 years in solar energy

- EnerWorks Staff
  - Total current staff of 35
    - 9 Engineers
    - 10 Scientists or Engineering Technologists
      - 4 of above with Masters or PhDs
  - 55% of employees with technical education

We have deeper technical talent than anyone else in solar thermal in North America

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Different Technologies

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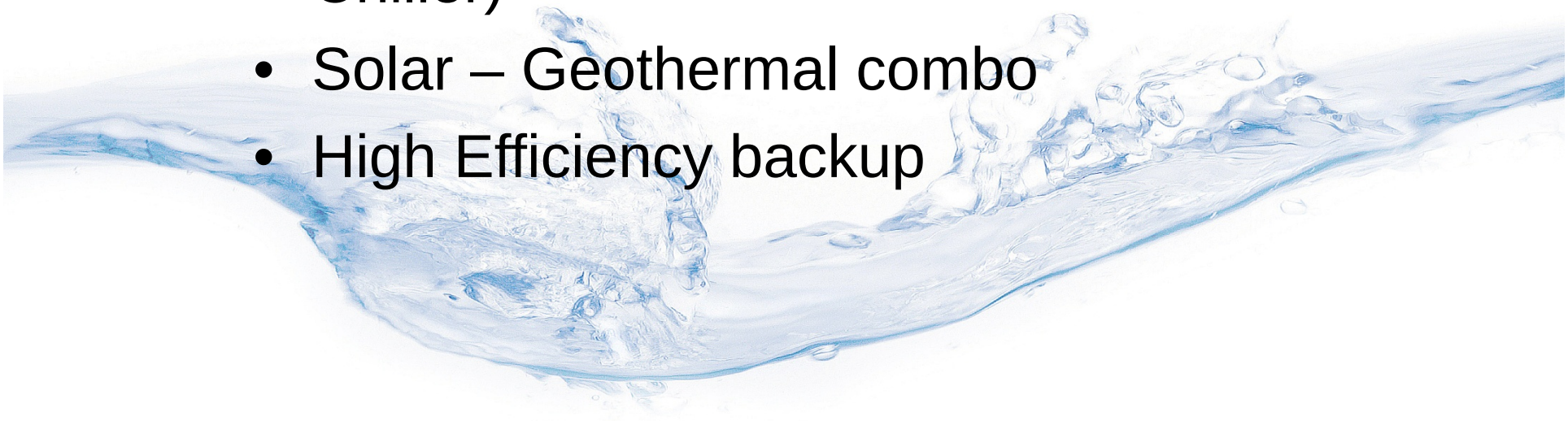
Solar Energy

- PV - Photo Voltaic
- ST – Solar Thermal Heating
- ST – Solar Thermal Cooling (Adsorption Chiller)
- Solar – Geothermal combo
- High Efficiency backup



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Solar Technology

- Solar Electric PV
  - Photo Voltaic
    - Transfer Sunlight into Electric Energy
- Solar Thermal
    - Transfer Solar Radiation into Heat Energy

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PV – Photo Voltaic

- Solar electricity
  - Off grid
  - Into grid

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Solar Thermal Technology

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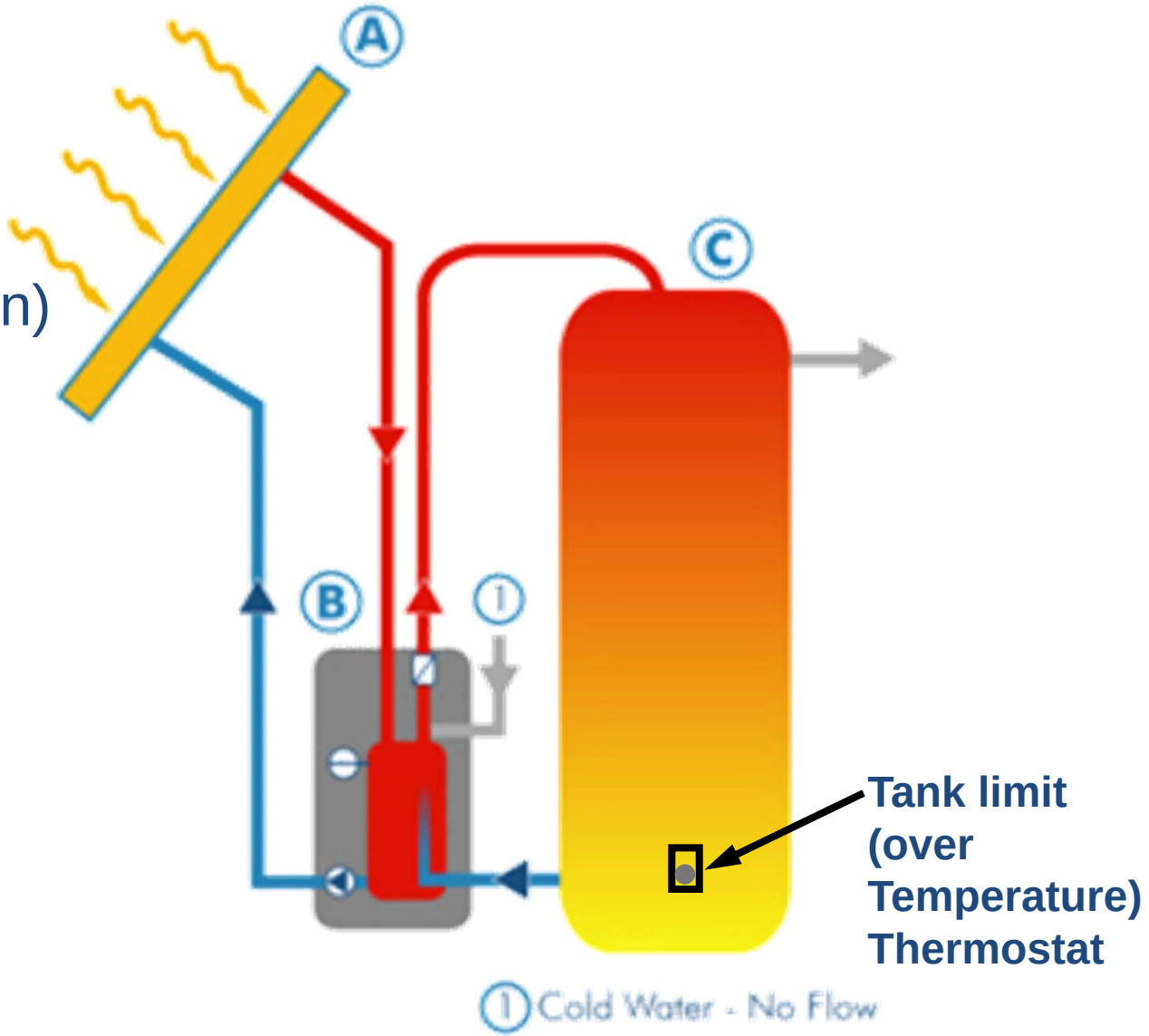
How Does Smart Solar Work?

Flat Plate Technology

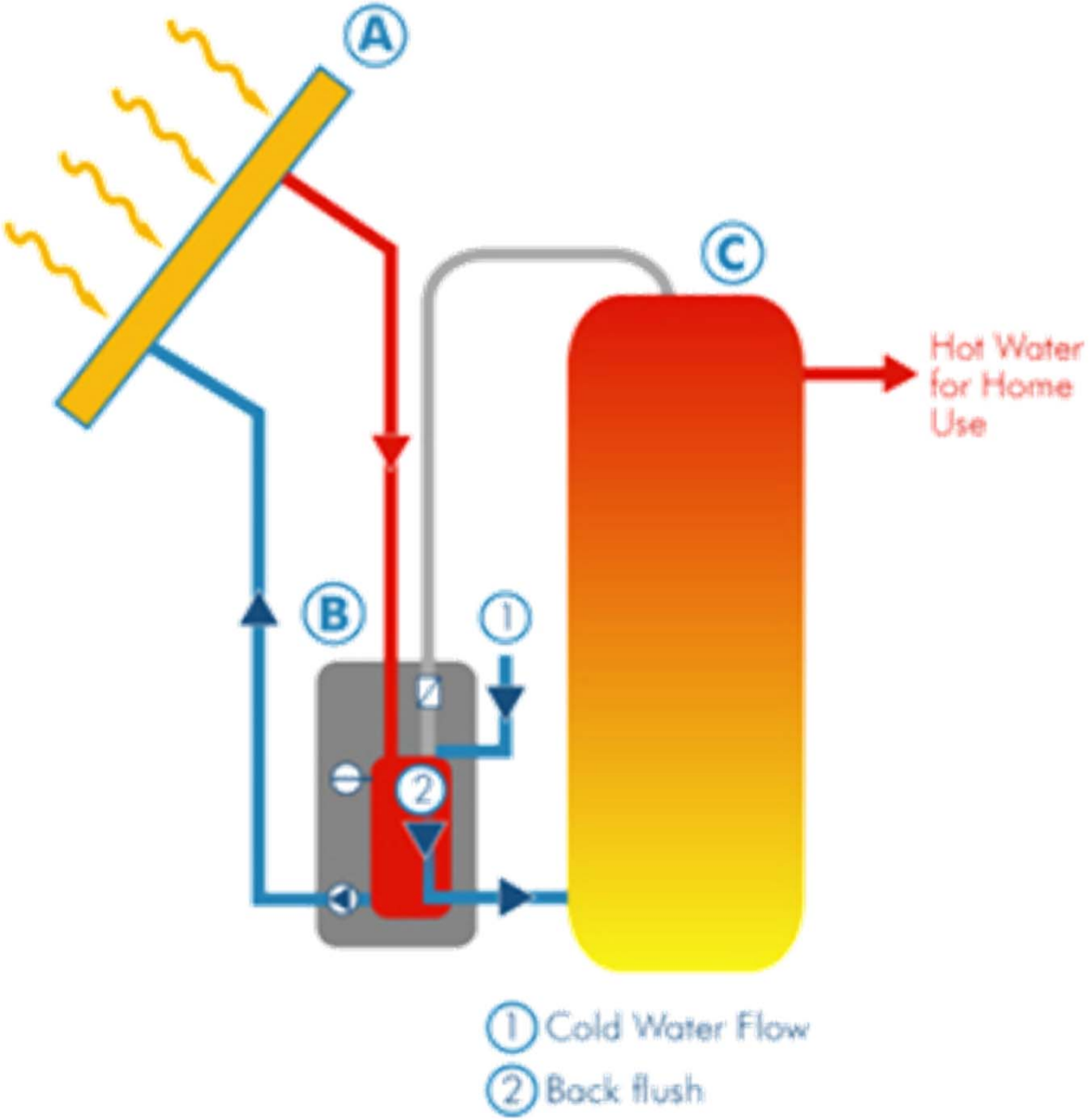
Tank Charge Mode

(No water consumption)



Flat Plate Technology

Hot Water Delivery Mode



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Solar Thermal History and other Solar Technologies

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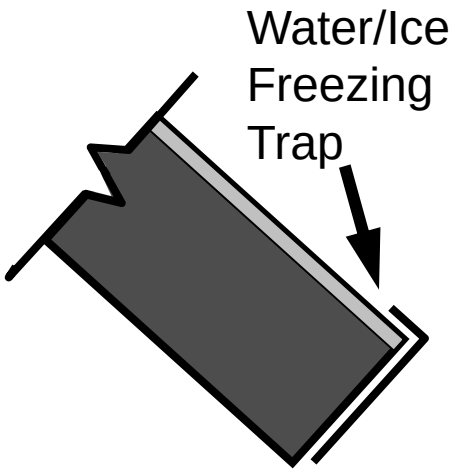
Solar thermal has been around a long time… BUT

- Water on the roof caused systems to freeze
  - destroyed the system
- The panels got so hot the water boiled
  - destroyed the system
- Hard water caused systems to scale-up
  - reduced system efficiencies
- Sunshine, rain, hail, snow, etc. all damaged the panels
  - systems had high failure rates
- Soldering ½" pipes from a roof to a basement is difficult
  - installation costs were too high
  - leak prone



Solar Panel

*Smart Solar does <u>not</u> have this trim plate which allows water, snow and ice to easily shed

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Dr. Steve Harrison… a new approach with Enerworks

- Queens University Professor of Engineering
- Director of Solar Calorimetry Lab
- 30 years experience in solar energy

- Project begun in 1992
- Objective
  - Design an affordable yet reliable solar thermal product with low installation costs and in compliance with CSA (Safety) certification

Solar Thermal Market Dynamics in NA

Pre-EnerWorks:

- Wide variety of component suppliers
- Fragmented – older technology
- Unreliable production capacity; unable to scale
- Most sell components with specialized storage systems; long, complex installs; unreliable
- Result: In NA, low adoption to date

EnerWorks manufactures a turnkey, certified “appliance” that integrates into existing residential or commercial infrastructure, addressing industry wide issues of reliability, install time & complexity, cost, reliability

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Solar Thermal

Low Temperature

- Inexpensive
- Swimming pools
- Low Tech.

Medium Temperature

- Medium Cost
- Potable Hot Water
- Medium Tech.

High Temperature

- Expensive Concentrators
- Steam for Power Generation
- High Tech.

Smart Solar & Ener**Works** focus is the Medium Temperature segment

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EnerWorks **Solar** Thermal Solutions

- Medium temperature 130 – 140 ºF (54 – 60 ºC)
- Active systems
- Pre-heat
- Displaces, not replaces

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Medium Temperature Solar Thermal

Drain Back / Drain Down

- Questionable freeze protection
- Lower cost than EnerWorks
- No IP…multiple players

Vacuum Tube

- Low Quality imports often from China
- Unattractive visually
- Not “appliance-like” = high installation costs

Flat Panel

- Automation friendly … lower costs
- Best looking option (very important)
- EnerWorks is freeze and overheat protected
- Appliance-like = low installation costs

Flat Panel based “appliance” offers the best total package for North America

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Solar Thermal

- Domestic Hot Water Heating
  - Vacuum Tube or Flat Plate

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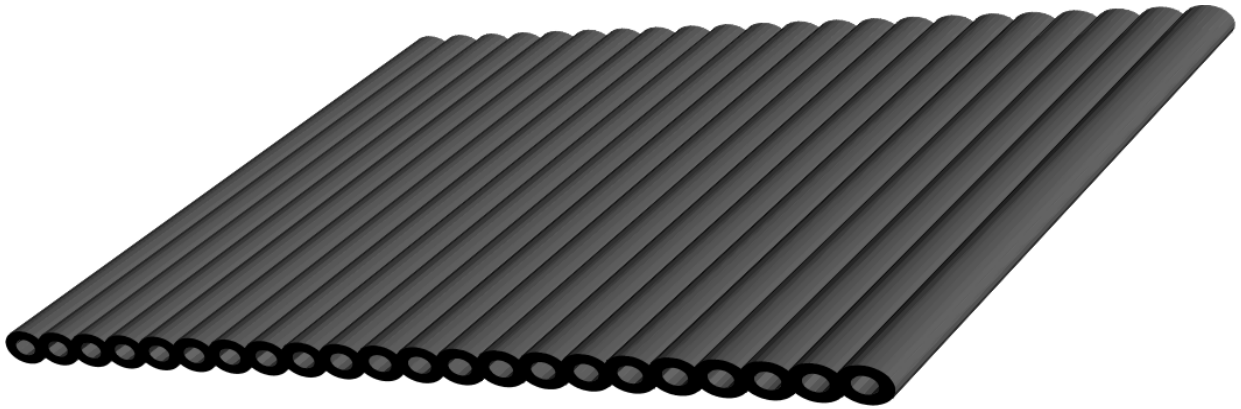
Collectors

- Collector Types
  - Outdoor Swimming Pool



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Pool Collectors

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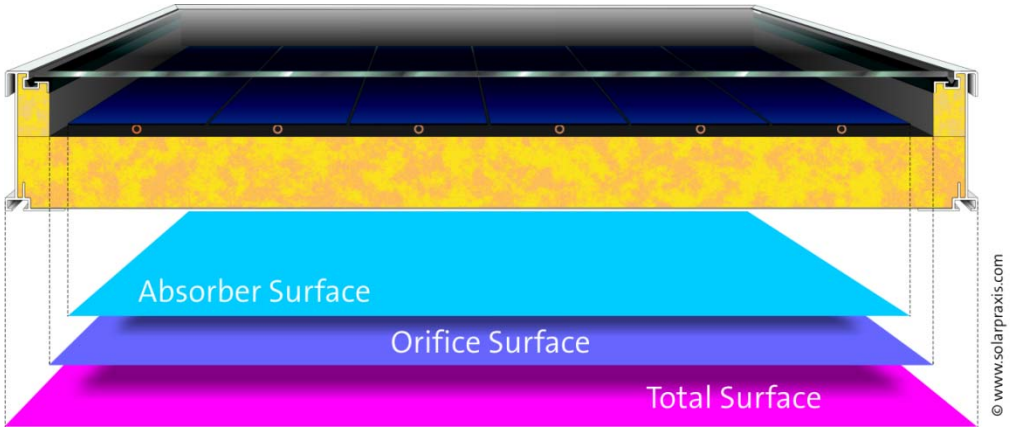
Collectors

- Collector Types
  - Flat Plate



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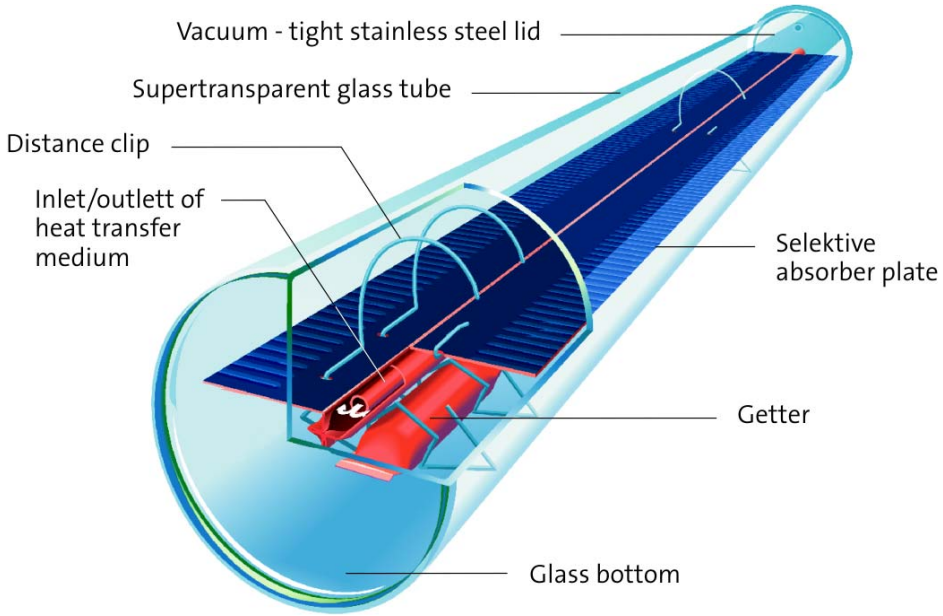
Collectors

- Collector Types
  - Vacuum Tube



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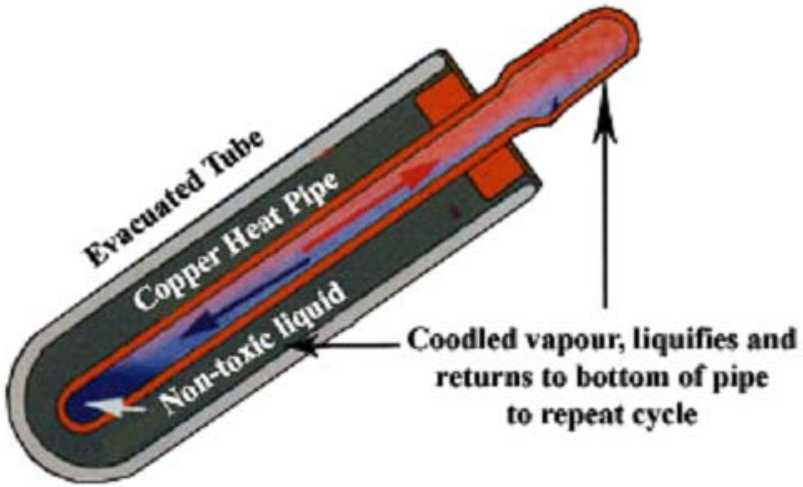
Vacuum Tube Collectors



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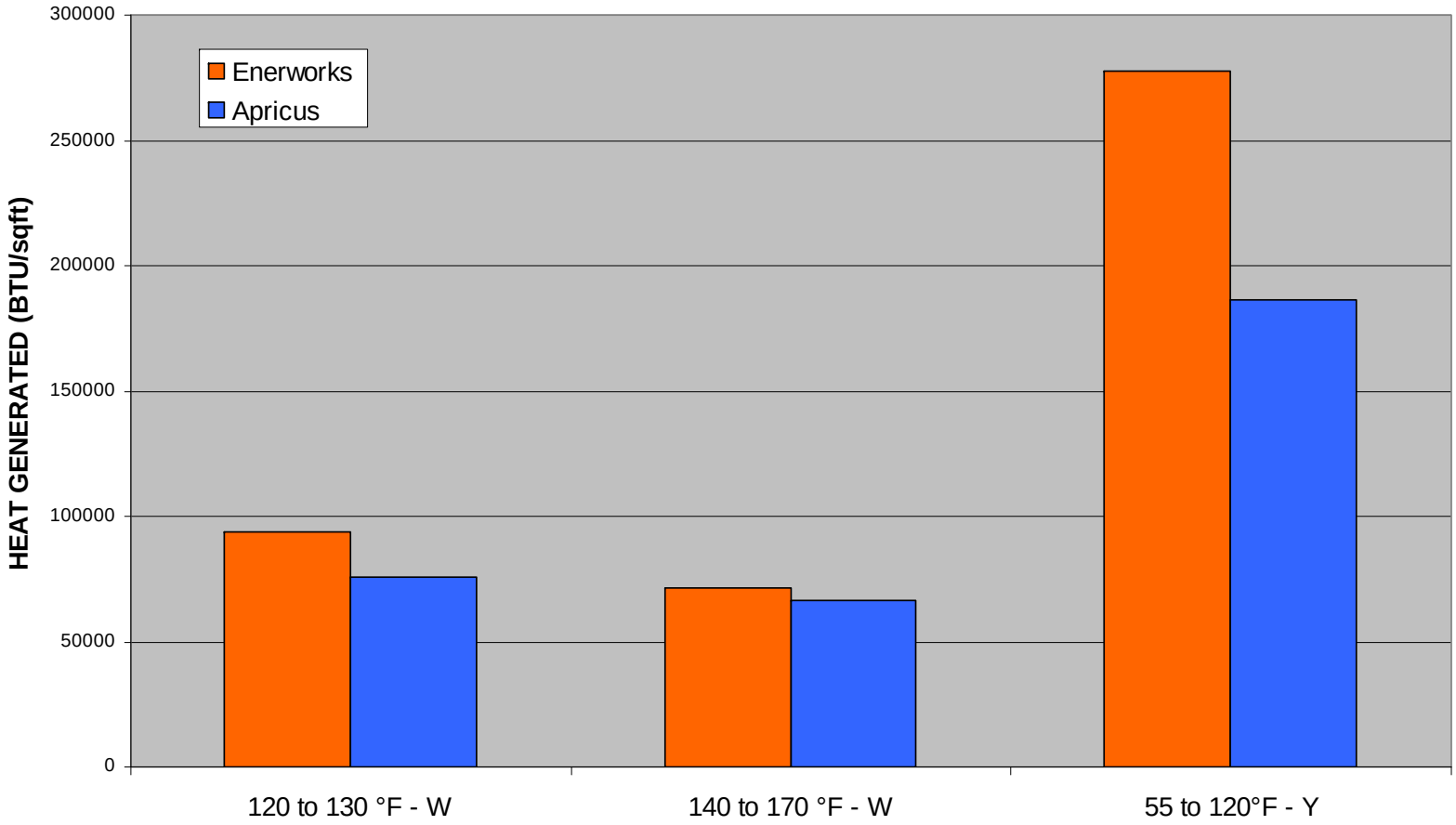
Vacuum tubes are (NOT) more efficient than flat plate collectors



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Collectors

- Collector Types
  - Concentrator

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System Type

- **Drain back**

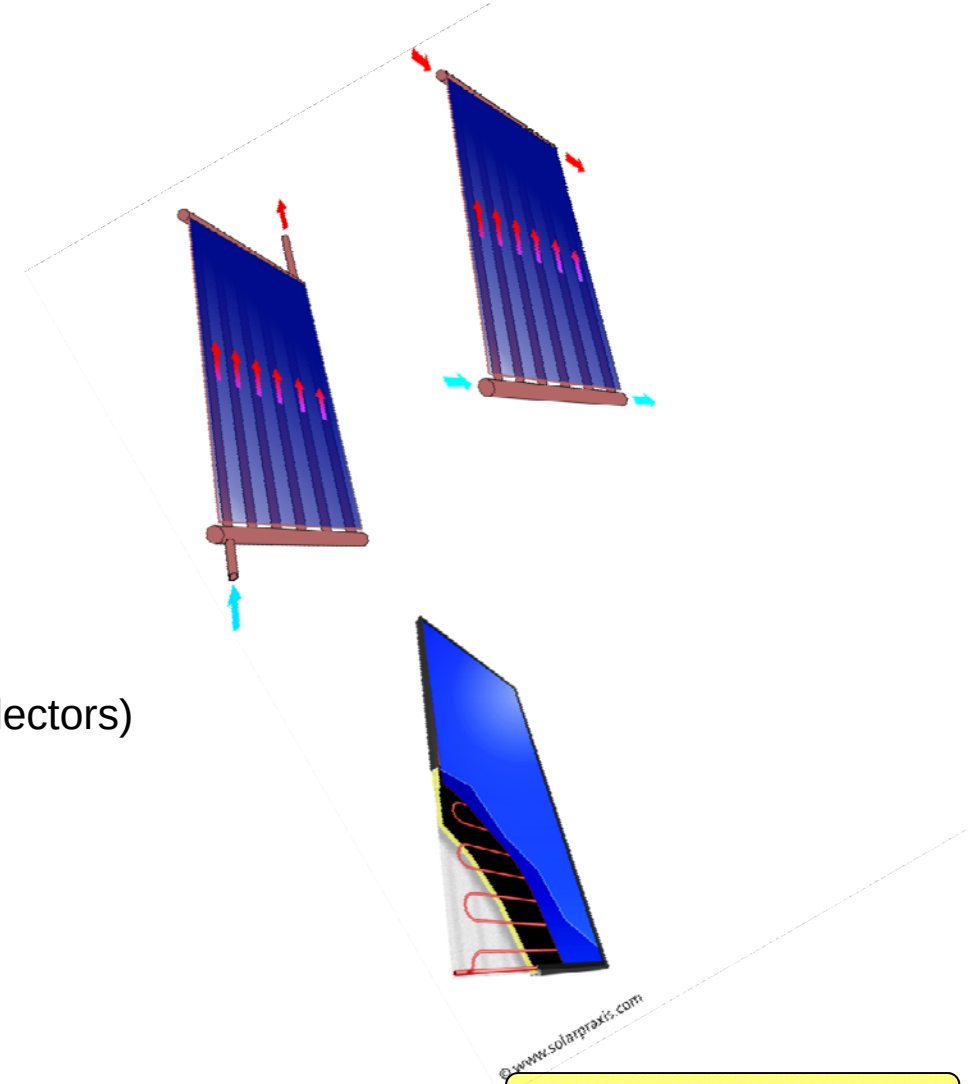
  (uses heat exchanger)

- **Drain down**

  (potable water flows through Collectors)

- **Closed Loop**

  (uses heat exchanger)



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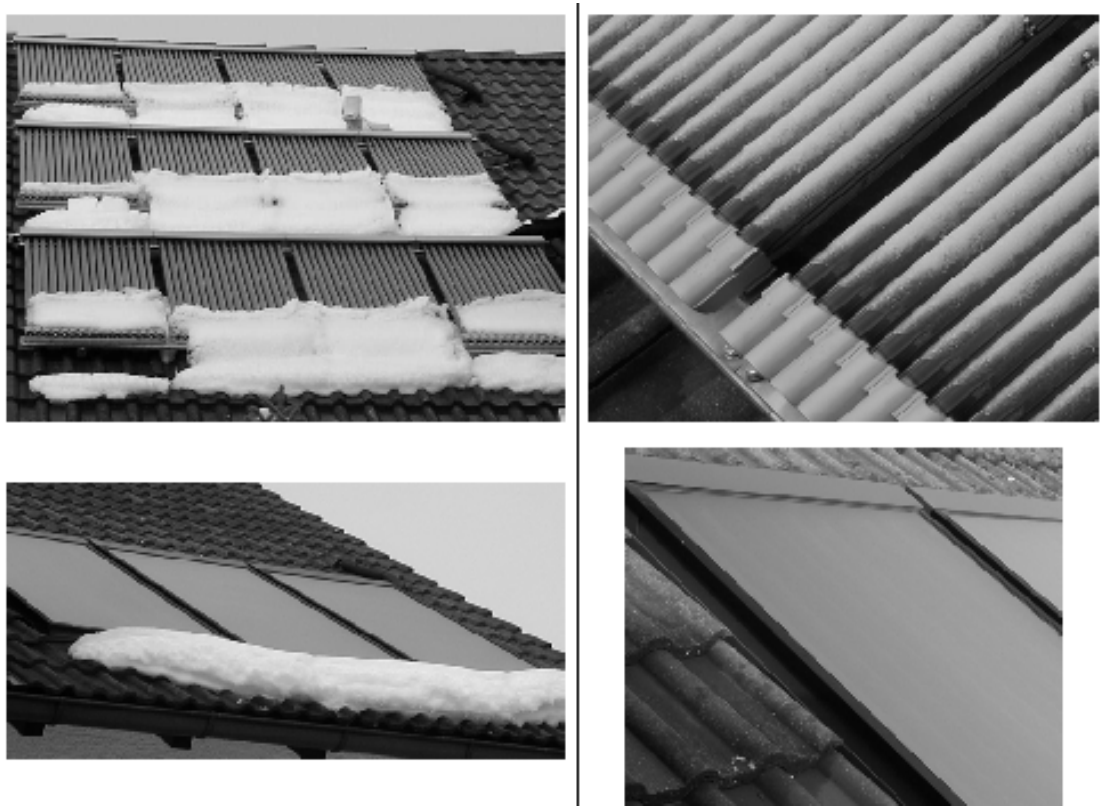
Winter Snow and Ice



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EnerWorks Technology

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EnerWorks Advantages

- Simple design
- Fast easy installation
- Easy Maintenance
- Venting Collectors
- Self-flushing heat exchanger
- Install cost advantage
- Energy for less $ than conventional energy

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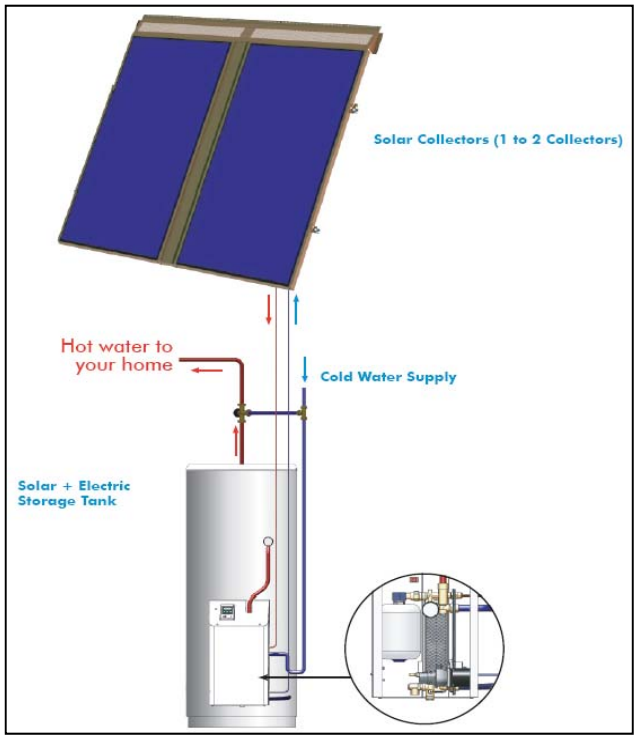
Winning Formula

- Freeze & over-heat protection
- Certifications
- Strong installation track record
- Great government rebates
- Excellent quality
- Wireless monitoring
- Great looking product
- Superb engineering
- Lowest cost alternative energy
- Payback 5 to 7 years*

*Compares to electric hot water and energy price escalation

Best value



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Competitive Positioning:

Worst Mid Best

	Price	Quality	Over-heat Protection	Ease of Installation	Freeze Protection	Certification (CSA , SRCC, etc.)	Aesthetics (Skylight)	Appliance Format	Wireless Monitoring
EnerWorks	Mid	Best	Best	Best	Best	Best	Best	Best	Best
Heliodyne	Mid	Mid	Worst	Mid	Best	Mid	Best	Mid	Worst
Stiebel Eltron	Worst	Best	Worst	Mid	Best	Mid	Mid	Mid	Worst
AET	Best	Mid	Worst	Worst	Mid	Mid	Worst	Worst	Worst
SunEarth	Best	Mid	Worst	Worst	Mid	Mid	Mid	Worst	Worst
Thermo Dynamics	Mid	Best	Worst	Mid	Best	Mid	Worst	Mid	Worst
Schuco	Worst	Best	Worst	Mid	Best	Mid	Mid	Mid	Worst
Velux	Worst	Best	Worst	Mid	Best	Mid	Mid	Mid	Worst
Viessmann	Worst	Best	Worst	Mid	Best	Mid	Mid	Mid	Worst

EnerWorks is well ahead of its competitors in North America

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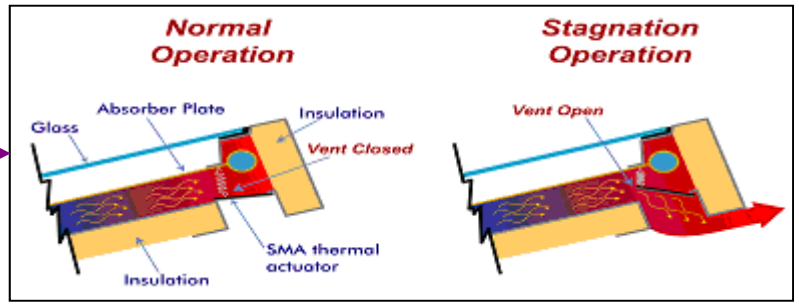
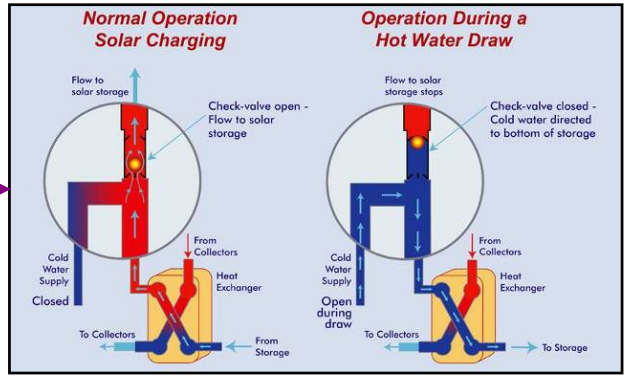
Intellectual Property

- Anti-stagnation
  - Patent granted
- Anti-fouling
  - Patent granted
- Wireless monitoring
  - Patent pending
- Low cost system design
  - Patents planned
- Micro-flow system designs
  - Deep know-how
- All aluminum system
  - Patents planned





Designed For Scalable Low-cost Manufacturing


Collector Manufacturing Line

- Manufacturing
  - Design for manufacturability
  - Proven product
  - Automation friendly production line
  - Source sub-assemblies

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EnerWorks Solar Thermal Solutions

- Saves money
- Reliable – year round
- *GREEN* alternative choice for ***ENERGY***

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Highlights

- Solar thermal market doubling each year in North America
  - Total N.A. market potential ~ $5 Bn/Yr
    - Current world market $5 Bn/Yr
- Solar thermal is the lowest cost renewable energy option
- EnerWorks patented product platform is best-in-class
  - Technology built on 20 years of research at Queens University
- Strong, experienced EnerWorks management team
- Combine with System 2000 for up to 50% energy savings

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Questions?

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Module # 2

SolSim

Follow along with this module and page number in your training binder

Module 2

Slide presentation courtesy of Enerworks

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Economics

- Solar Fraction (%)
- Cost per kWh*
- Incentives – Tax Credits – Rebates – Accelerated Depreciation
- Return on Investment (ROI)
- Payback – depends on future cost of conventional energy

*Lock into a low energy price for life of installation

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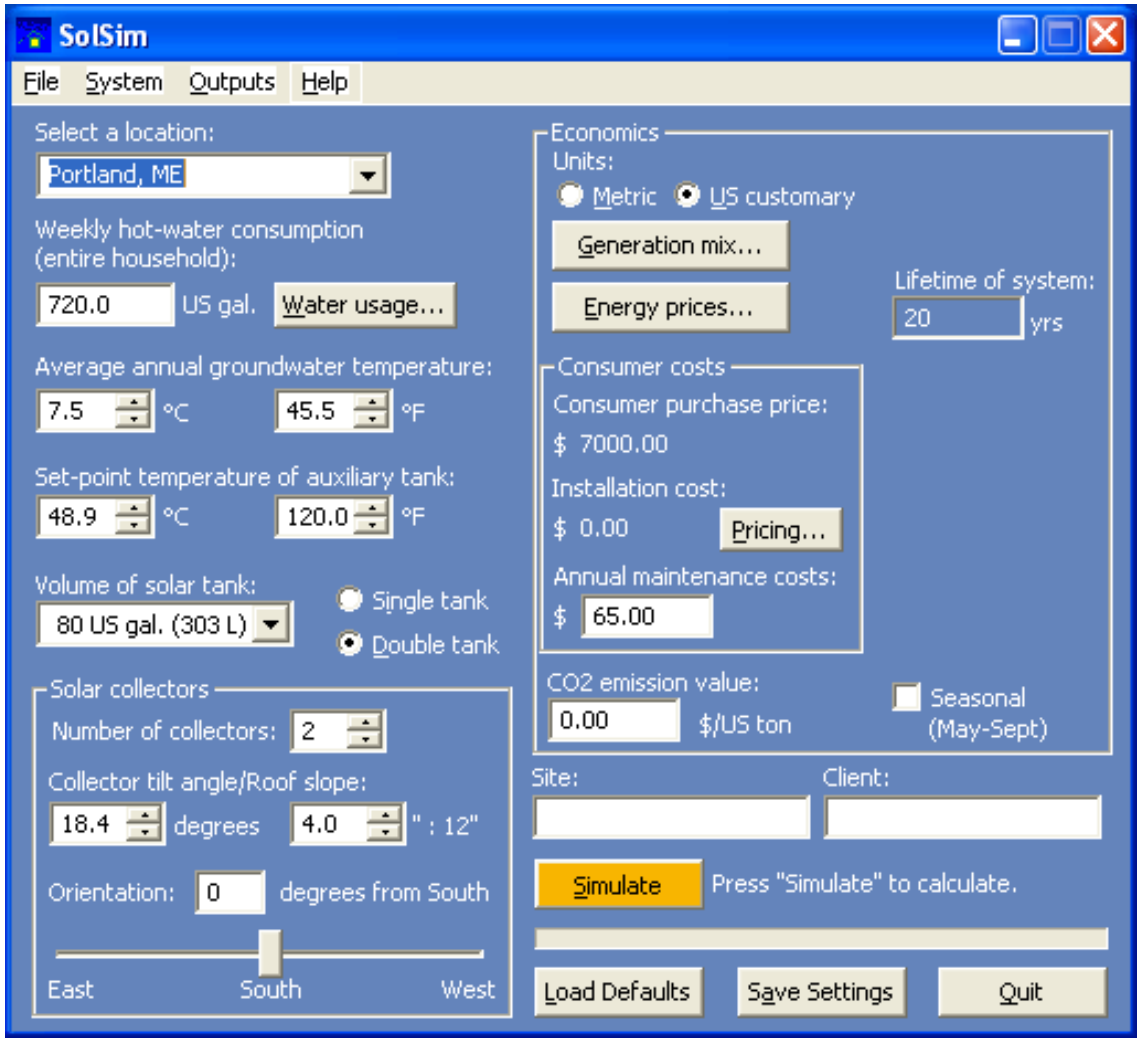
SOLSIM

- Computer modeling software
- Performance and economics
- Design and sales



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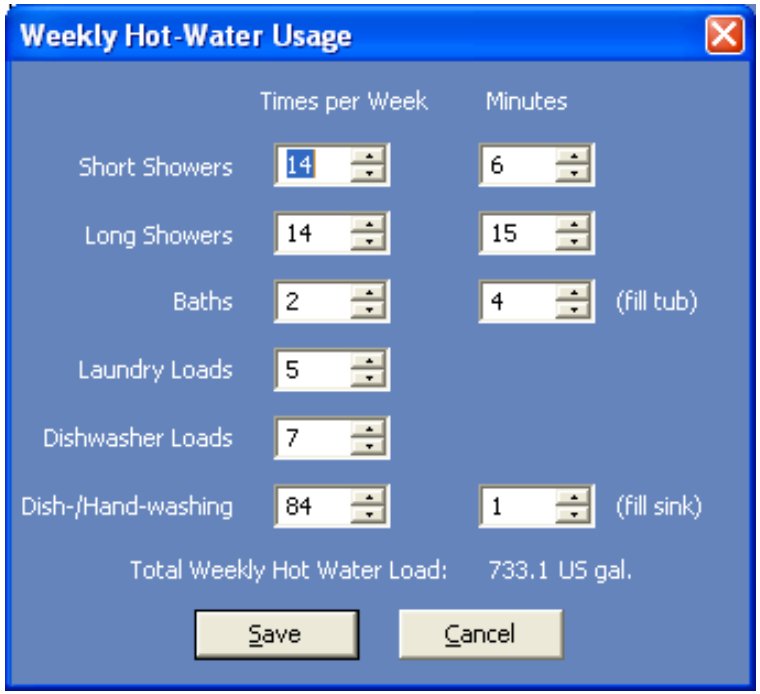
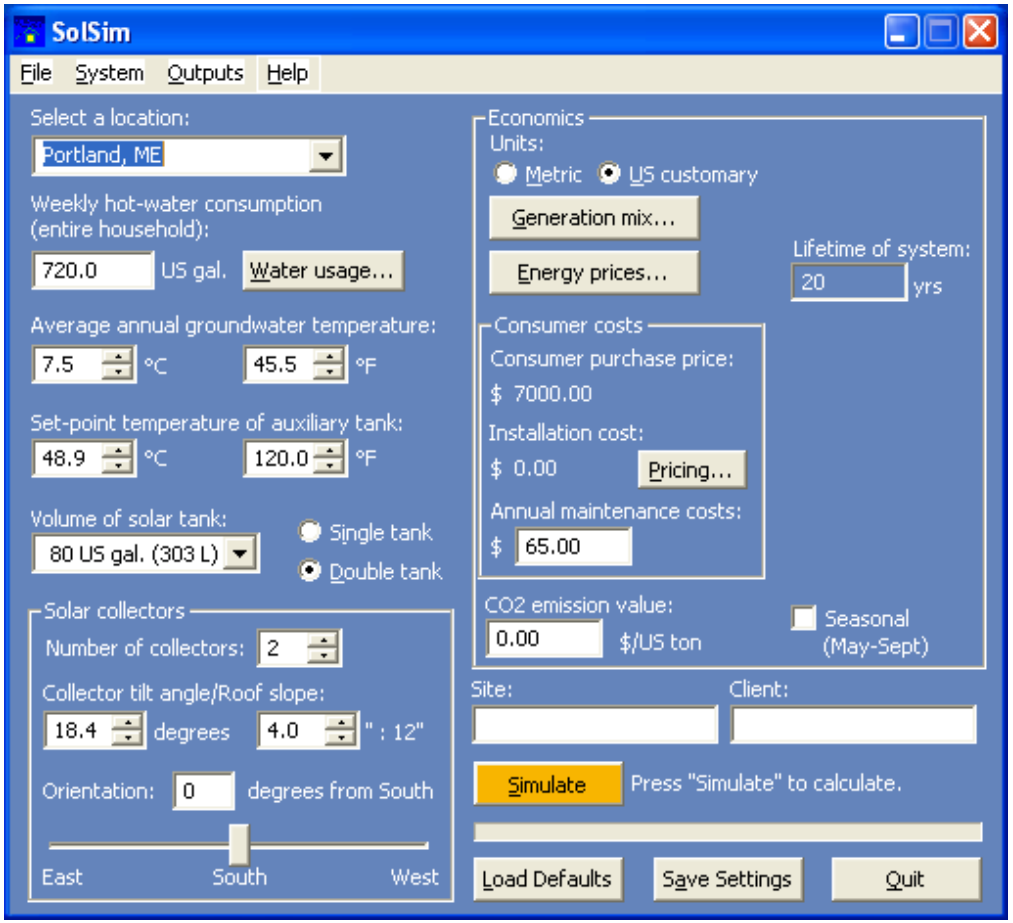
SOLSIM

- Weekly hot water usage?





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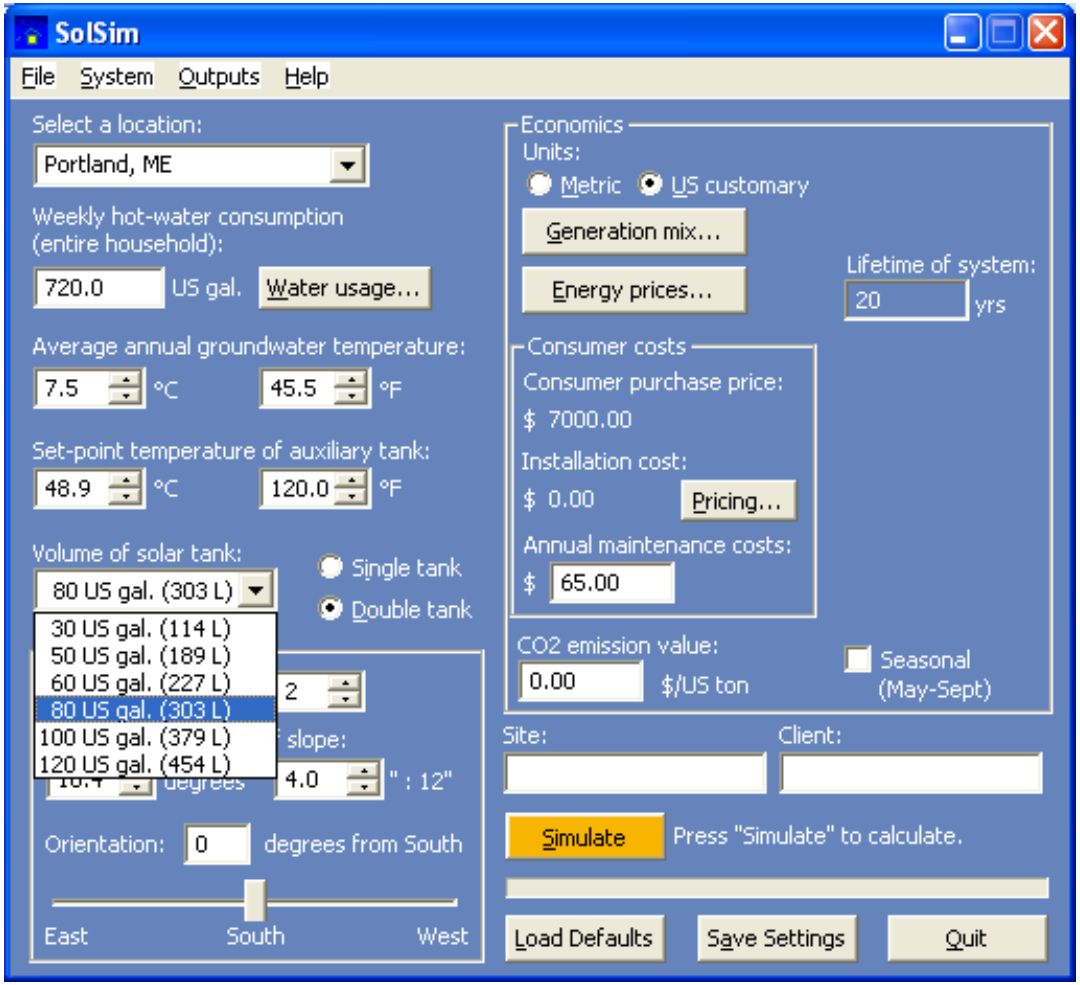
- Average groundwater temperature
- Water-heater set-point temperature
- Solar storage tank size?
- Single or two- tank Appliance?



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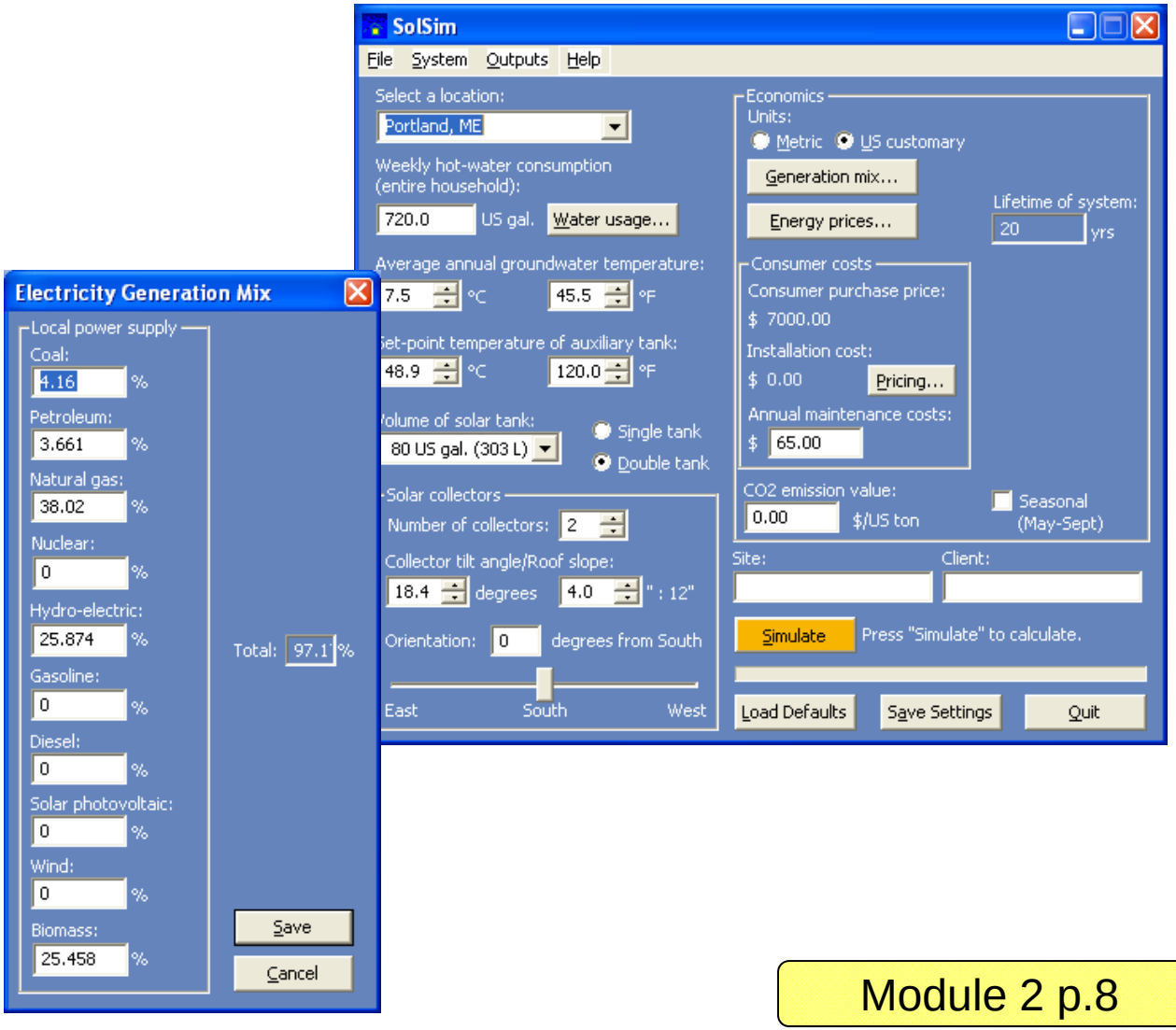
SOLSIM

- Electricity generation emits CO_2
- Heating water with electricity generated by burning coal and fossil fuels produces more CO_2 than by heating water with natural gas
- Electricity generation requires large volumes of fresh water for cooling



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SOLSIM

- Energy prices with appreciation

SolSim outputs

- Annual energy required for water-heating
- Annual energy cost
- Energy savings by using solar
- Dollar savings by using solar
- Payback
- Return on investment (ROI)
- Solar fraction
- CO_2 emissions

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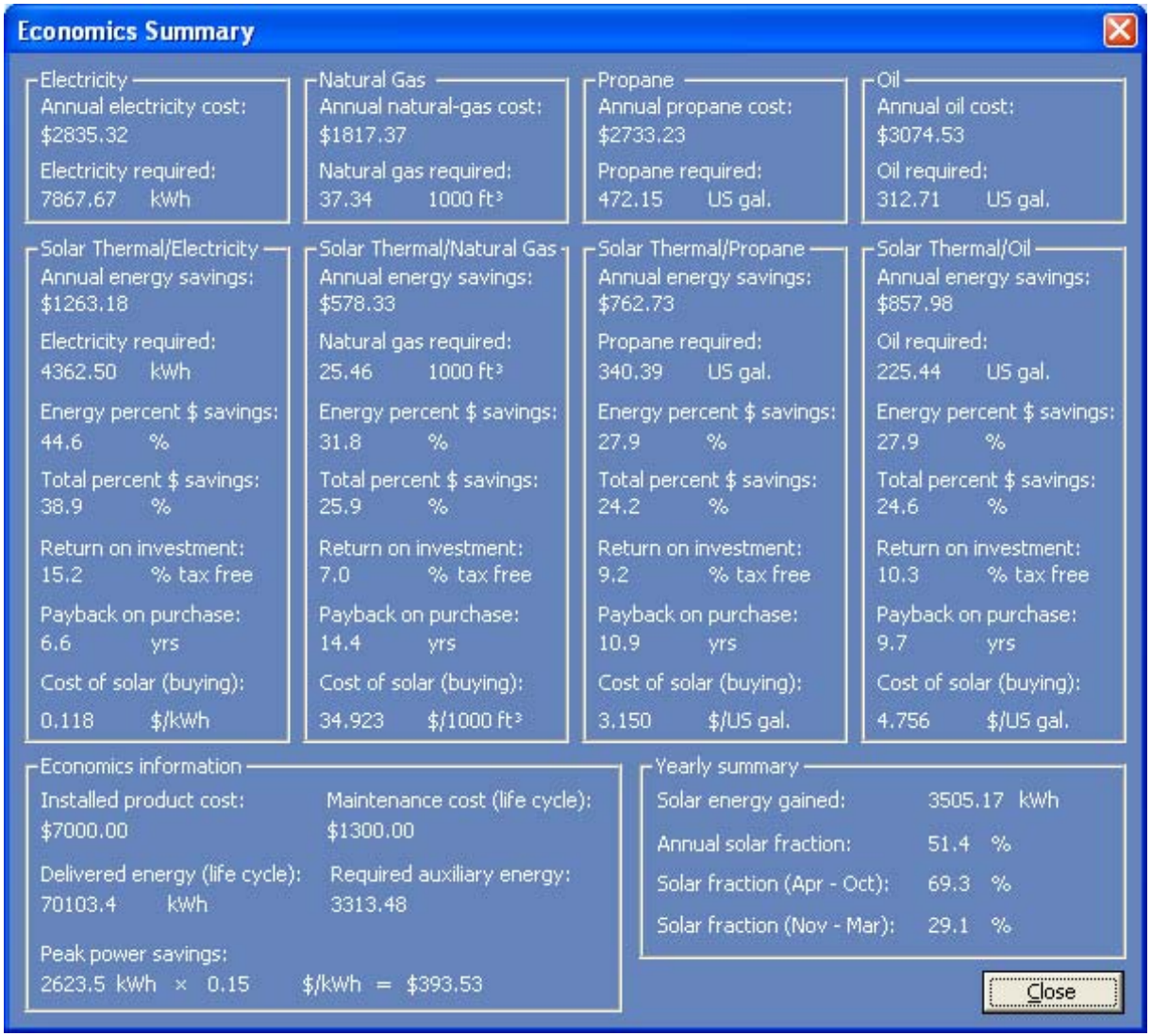

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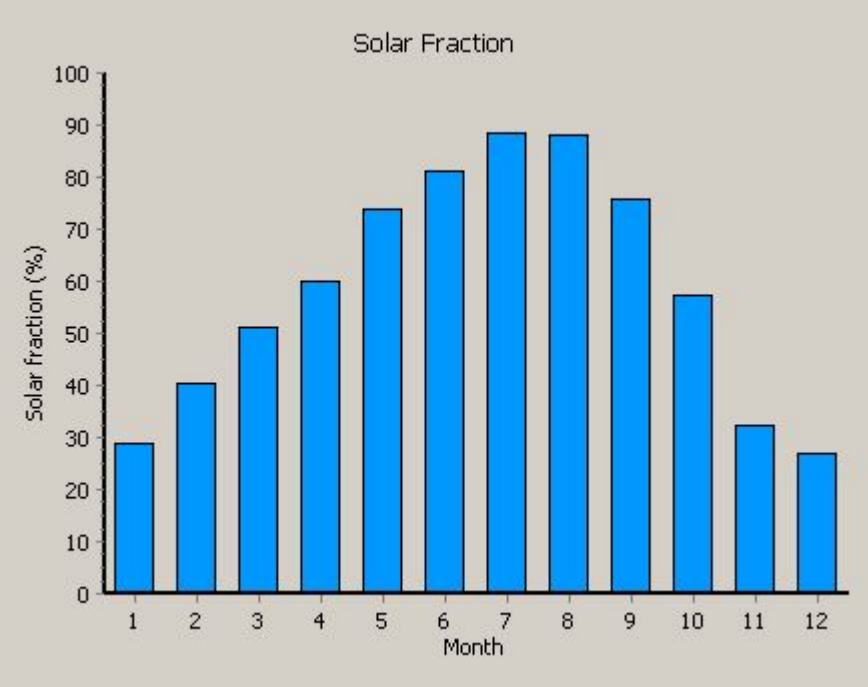
Annual Solar Fraction Graph



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Energy Savings - Canada

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Energy savings

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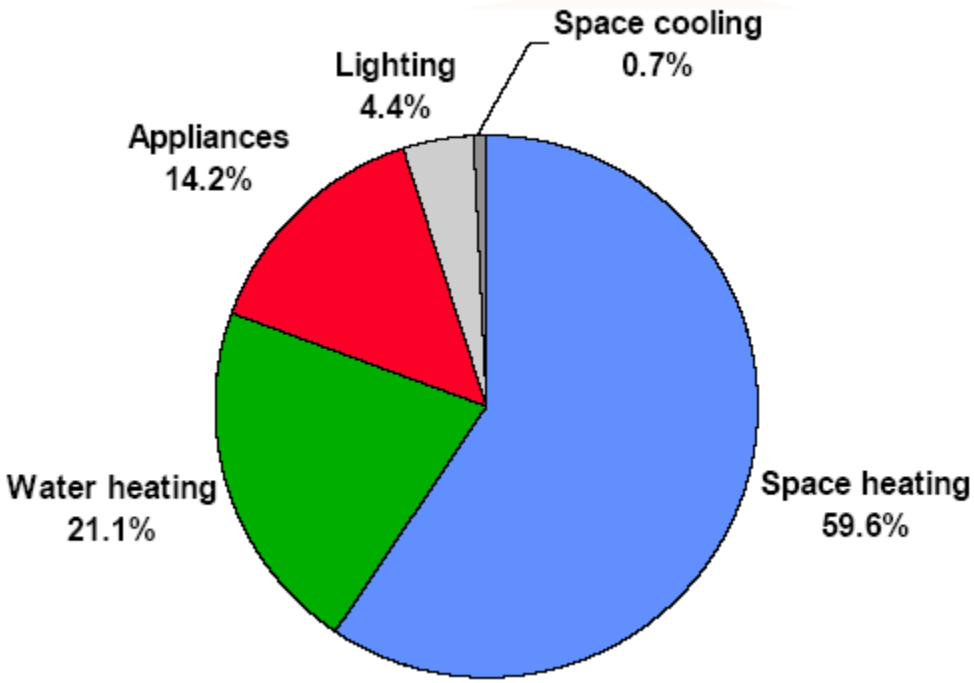
Domestic Hot Water and Solar

- Water heating is 20% to 30% of home energy use
- 50-60% of water heating can be supplied by solar
- That is more than 10% of total home energy saved by solar water heating



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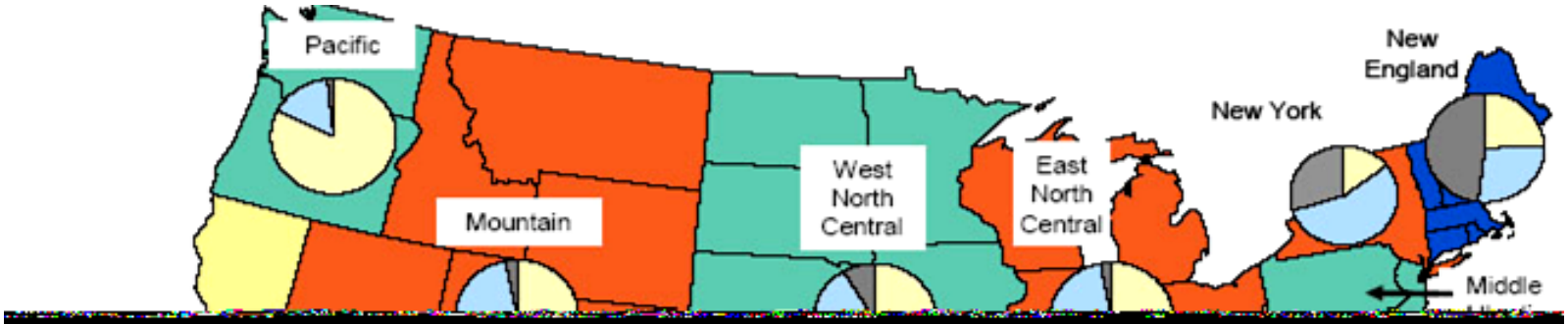
ENERGY KINETICS

Hot Water Heating Profile - US



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Emission Reductions

- **Solar Thermal & Natural Gas**

  Approximately 1.25 TONS $C0_2$
  Per Installed System per year.

- **Solar Thermal & Electricity**

  Approximately 1.0 TONS $C0_2$
  Per Installed System per year.

- **Based on 50% Solar Fraction**

  Emissions reductions will increase with higher Solar Fraction.

Assumes 55% fossil fuel in generation mix, 240L of hot water at 55 degrees Celsius per day
Toronto, Ontario, Canada.

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Questions?

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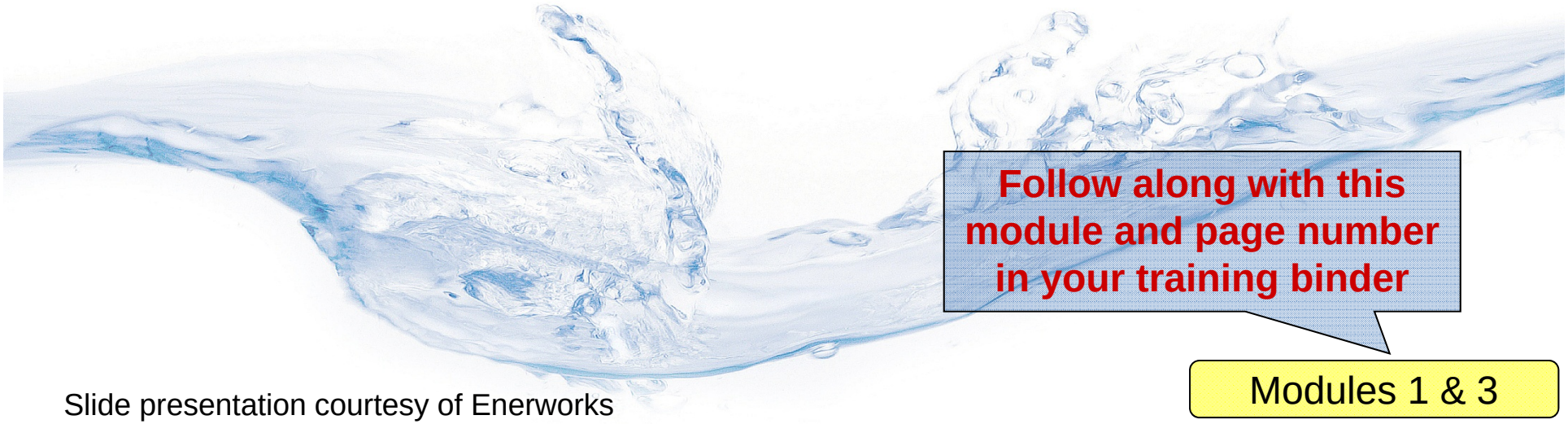
Module # 3

Selection, Sizing and Site Evaluation



Follow along with this module and page number in your training binder

Modules 1 & 3

Slide presentation courtesy of Enerworks

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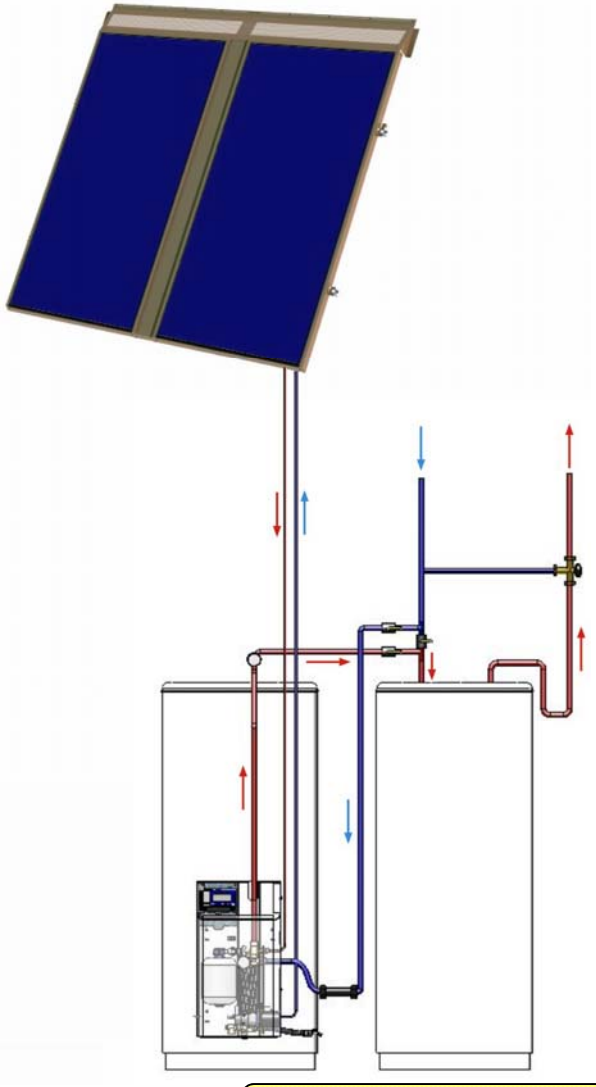
- Solar collectors heated by sun
- Heat-transfer fluid pumped through solar collectors
- Heat transferred to water through heat-exchanger
- Solar storage in series with auxiliary tank
- When hot water is used, solar storage water flows into auxiliary tank



Module 3 p.5 - 6

SMART SOLAR™
ENERGY KINETICS

EnerWorks Space-Saver™ Residential Solar Water Heating Appliance

- One-tank system reduces footprint
- Combines solar and System 2000 stratification with heat exchanger (6” dip tube and second aquastat)
- Tank stratification prevents mixing of solar and System 2000 generated hot water
- The high performance system uses a pre-heat tank (2-tank system)

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Number of collectors depends on water use and number of people

- 1 - 3 people: 1 collector
- 4 - 6 people: 2 collectors
- 7+ people: 3 collectors
- small commercial: 4 collectors
- 2 – collector and more systems generate over 6,000 mJ to qualify for ENERGY STAR

Solar Storage volume depends on number of collectors

High-Performance Appliance

- 1 - 3 people: 1 collector – 50 gal US
- 4 - 6 people: 2 collectors – 80 gal US
- 7+ people: 3 collectors – 120 gal US
- Small commercial: 4 collectors – 120 gal US

Space-Saver™ Appliance (may not be suitable in northern States)

- 1 - 3 people: 1 collector – 80 gal US
- 4 - 6 people: 2 collectors – 120 gal US

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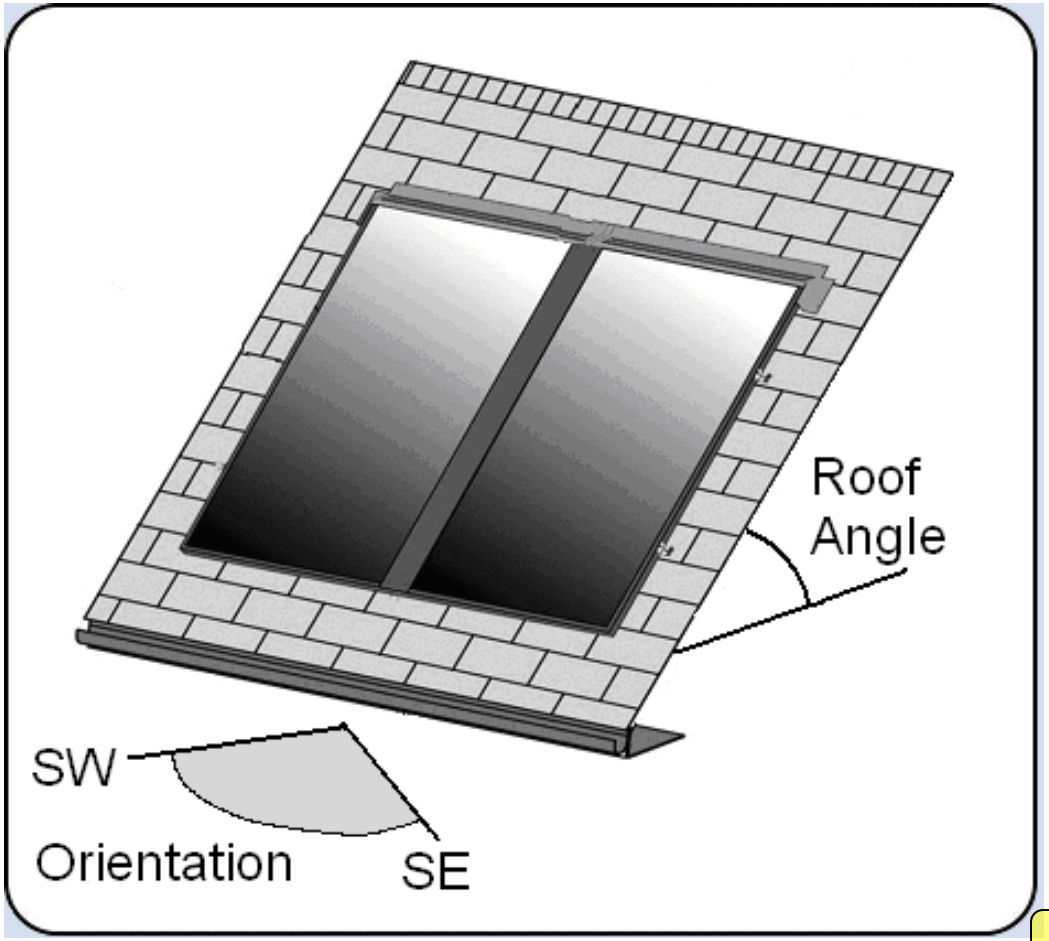
ENERGY KINETICS

NA Average Hot Water Usage/Person/Day

18.5 USG

70 L

Optimal Collector Positioning



Module 3 p.12

Positioning of Collectors

Rules of Thumb

- For a year-round solar system , the best performance is from collectors facing due south, tilted at an angle equal to the latitude of the location and never shaded.

- For a summer-only system, such as pool-heating, the tilt angle will be at a shallow angle.

- If most of the use is in the winter, the panels will be at a steeper angle to capture the sunlight at lower sun altitude angles.

Summer Biased: Latitude – 15^{o}
Winter Biased: Latitude + 15^{o}

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Solar Fraction:

Amount of total hot water demand provided by solar

Solar Fraction	Collector Angle	14°	**18°**	**27°**	**34°**	**37°**	**45°**	90°
	Roof Pitch	3:12	**4:12**	**6:12**	**8:12**	**9:12**	**12:12**	wall
Collector Azimuth	East	56%	55%	53%	51%	49%	47%	22%
	SE	63%	64%	65%	64%	64%	62%	34%
	South	68%	**70%**	**73%**	**74%**	**74%**	**73%**	41%
	SW	67%	**70%**	**73%**	**76%**	**76%**	**77%**	53%
	West	61%	62%	64%	65%	65%	65%	47%

SolSim: Albuquerque, family of four using 733 gal US of hot water per week, 2-collector High-Performance Appliance with 80 gal US solar storage

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Solar Fraction with Various Orientations

Collector Azimuth (orientation)	0	15	30	45	60	75	90
East	44%	43%	42%	39%	35%	29%	23%
SE	44%	48%	51%	50%	47%	41%	32%
South	44%	51%	55%	56%	53%	45%	35%
SW	44%	49%	53%	54%	52%	46%	37%
West	44%	44%	45%	43%	41%	36%	30%

Collector Angle (degrees)

Toronto, 2000 liters per week, 2 collector appliance using SOLSIM

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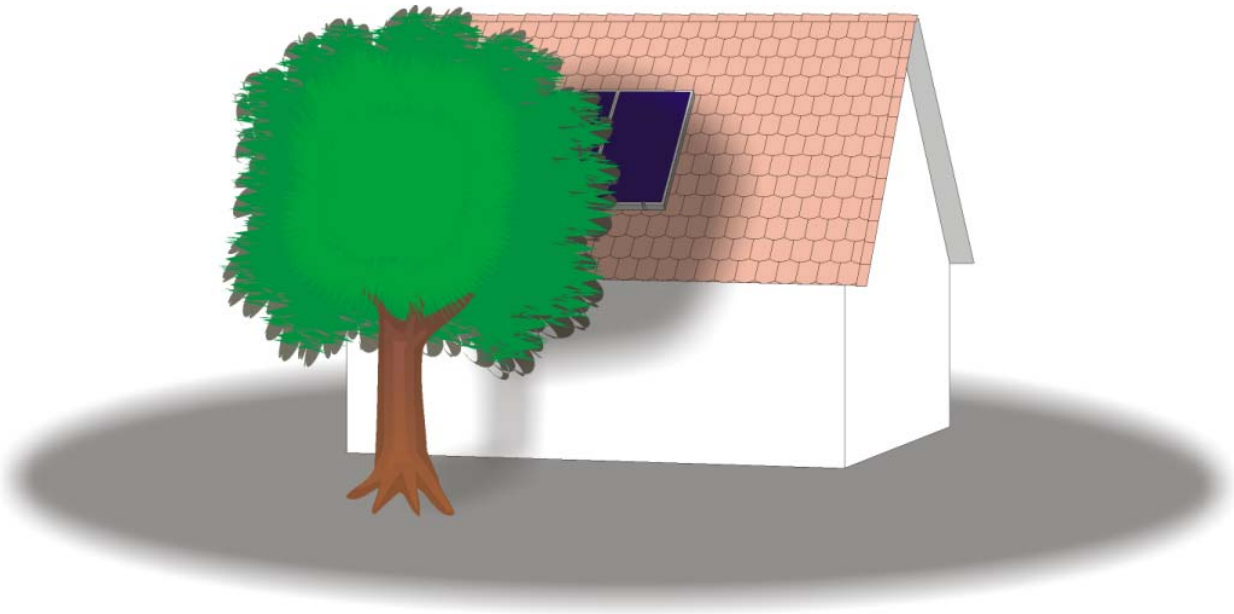
Shading



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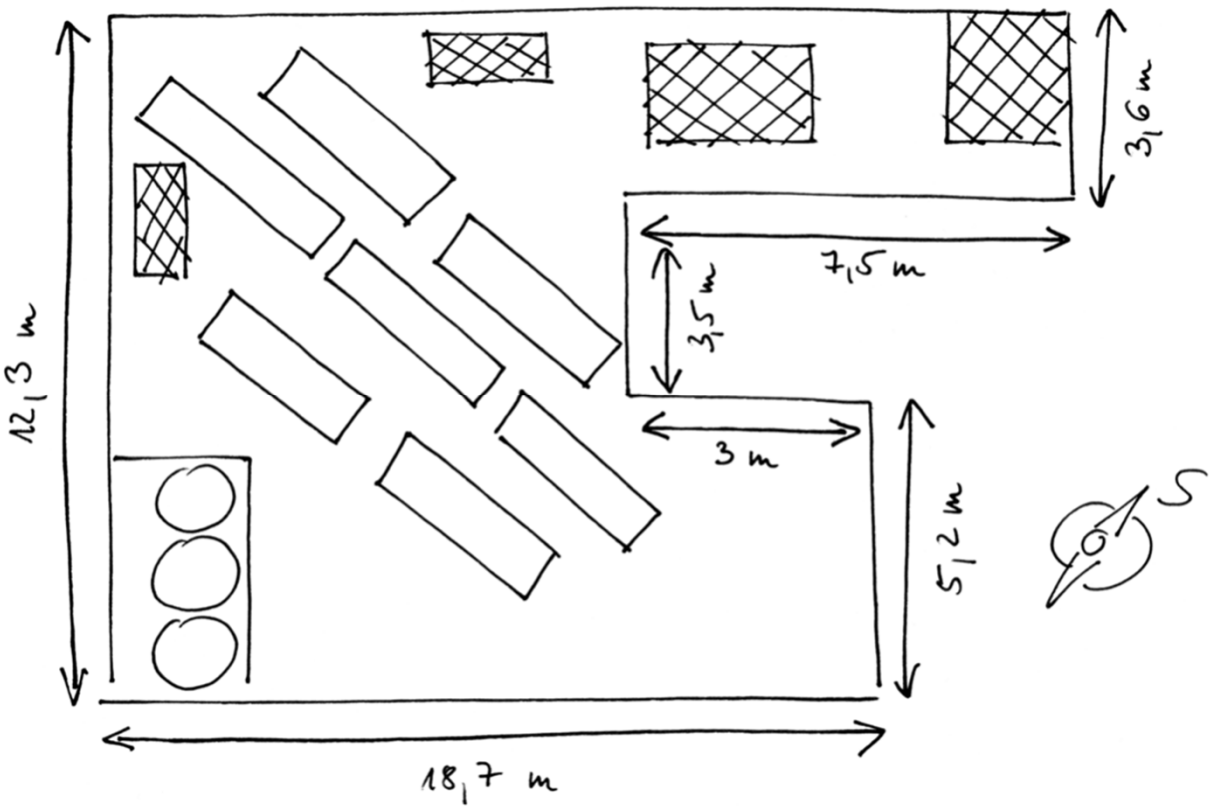
Site Inspection

- Roof



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Residential Site Survey

PREPARED BY

Name _____ Phone 1 _____
Company _____ Phone 2 _____
Address _____ Fax _____
_____
City _____ e-mail _____
State/Prov _____
Post Code _____ www.

CUSTOMER

Name _____ Phone 1 _____
Address _____ Phone 2 _____
_____ Fax _____
City _____
State/Prov _____ e-mail _____
Post Code _____

SITE

Same as above ☐ Coordinates _____ ° _____ ' _____ N
Name _____ _____ ° _____ ' _____ W
Address _____ Phone 1 _____
_____ Phone 2 _____
City _____ Fax _____
State/Prov _____
Post Code _____ e-mail _____

WATER

Municipal mains ☐ Hardness _____ GPG ppm mg/L
Community well ☐ *(if >29 GPM or >500ppm, water softener must be in place)*
Private well ☐ Turbidity _____ GPG ppm mg/L
Lake/River ☐ Metals _____
Rain ☐ Water analysis _____
Chlorine shock ☐ *(Energy Pack must be bypassed if water is shocked with chlorine or carbon filter must be in place)*

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ENERGY KINETICS

Residential Site Survey

WATER & ENERGY USE

Adults _____
Teenagers _____
Children _____
Total

Total water use _____ US gal Imp gal L daily ☐
(if not known, approx. 16 US gal, 13 Imp gal, or 60 L per person per day) weekly ☐
Hot water use _____ US gal Imp gal L monthly ☐
(if not known, approximately 1/3 of total hot water use) annually ☐

Existing water-heater
Brand / Model _____
Size _____ US gal Imp gal L
Age yrs

Electric ☐
Natural gas ☐
Oil ☐
Propane ☐
Storage tank ☐
On-demand ☐

Energy use _____ kWh BTU therm ft^3 m^3
monthly ☐ annually ☐

Cost of Energy $ _____
monthly ☐ annually ☐

Anticipated # of collectors

Solar storage tank size US gal Imp gal L

BUILDING

Age yrs # of stories

Line-set route
roof-penetration, exterior wall ☐
roof-penetration, interior ☐
around eave, exterior ☐
in ground ☐

Access to basement _____
Sill height above ground _____
Basement construction ☐ _____
Space for solar storage tank ☐ x _____
120 VAC available ☐

Plumbing material
copper ☐
PEX ☐
other

Size
½" ☐
¾" ☐
other

Roof cladding
Asphalt shingle ☐
Metal with raised seams ☐
Tile ☐
Other _____

Roof/collector direction
azimuth _____ °
magnetic _____ °
declination _____ °
true _____ °

Roof/collector pitch _____ : 12 or _____ °
Roof condition _____
Roof access _____

Module 3 p.16

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ENERGY KINETICS

Questions?

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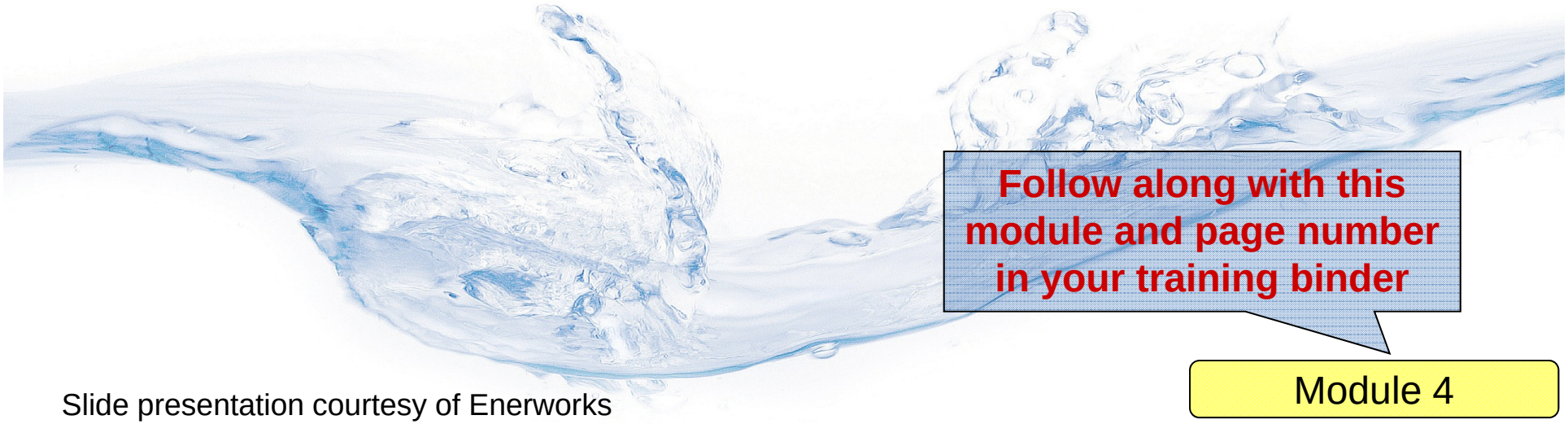
ENERGY KINETICS

Module # 4

Solar Collector and Line Set Installation



Follow along with this module and page number in your training binder

Module 4

Slide presentation courtesy of Enerworks

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Record the panel serial numbers on the job before installation.

Shipping

Pallet of 20 energy packs

Standard crate dimensions are:
- 48.5" wide
- 100" long
- 60" tall
- 1,350 lbs @ 10 collectors

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Product and Installation Registration Form

Date of Installation:	Water Hardness: GPG ppm, mg/L	Energy Pack Serial Number:
Customer Name:	Installer Name:	Solar Collector Serial Number: 1
Installation Address: Postal/Zip Code	Company Address: Postal/Zip Code	Solar Collector Serial Number: 2
		Solar Collector Serial Number: 3
Customer Telephone 1:	Installer Telephone 1:	Solar Collector Serial Number: 4
Customer Telephone 2:	Installer Telephone 2:	
Customer e-mail:	Installer e-mail:	Thermistor batch number:

Record the panel serial numbers and fax registration to Energy Kinetics.

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EnerWorks Solar Collectors

- Absorber has very high absorptance (94%) and low emittance (5%)
- Low-iron, textured glass limits absorption and reflection allowing for maximum transmittance
- Galvalume™ frame (4’ x 8’)
- Integrated stagnation control

  limits temperature and pressure

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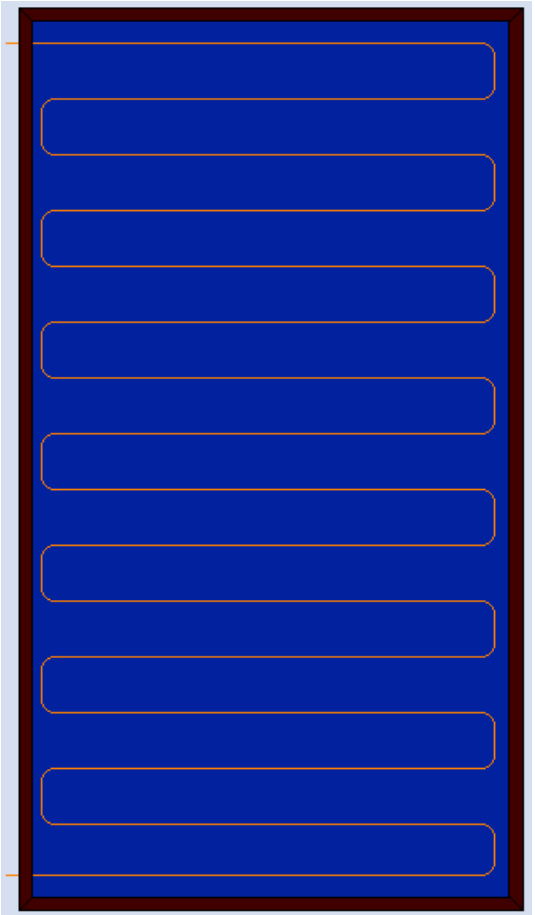
How it Works – The Solar Collector

- Serpentine Flow
- Residential collector:
  one continuous pipe (70’),
  no welds/internal connections,
  connected in series
- Commercial collector:
  ¾” headers, connected in parallel



Front View - Collector

Stagnation?

- Fluid stops circulating
  - Insufficient solar energy
  - Power failure
  - Solar storage is fully loaded with heat, system shuts down to prevent overheating

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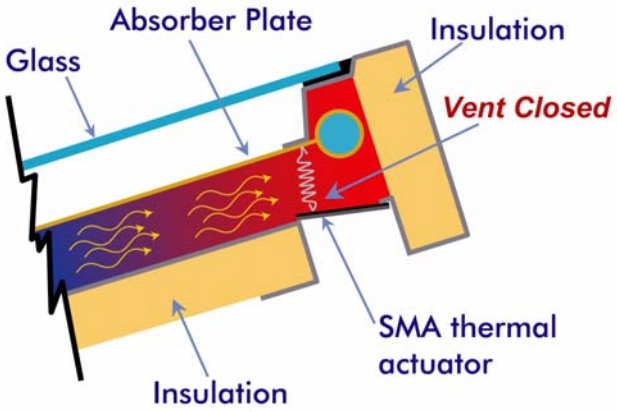
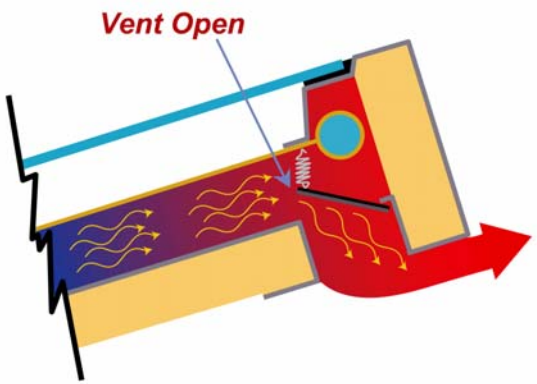
Self-limiting Collector

Normal Operation



Stagnation Operation



US Patent # 7,143,762 B2

EnerWorks

SOLAR CALORIMETRY LABORATORY
Queens University

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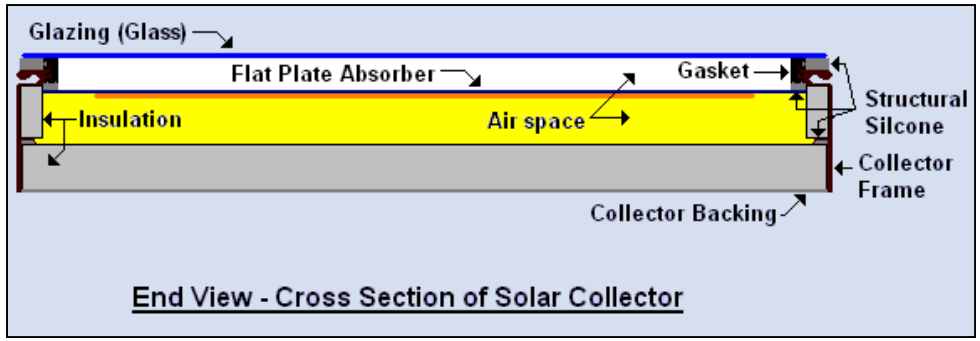
ENERGY KINETICS

How it Works – The Solar Collector

- Air gap allows air flow behind absorber
- Air flow removes excess heat to environment



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Integrated stagnation control

(US Patent # 7,143,762 B2)

- Limits temperature (below 260°F) at collector, prolonging heat-transfer fluid life and improving performance
- Limits pressure, allowing a 50 psi relief valve, a small expansion tank and a small, effective single-wall heat-exchanger
- SRCC / FSEC / IAPMO / CSA certifications

SOLAR SRCC CERTIFICATION ®

USEC ®

232023

Roof Preparation

- Safety – Fall safety course, appropriate anchors, equipment and practices
- Determine location of rafters – How?
- Pre-drill roof and fill hole with polyurethane roofing sealant
- Mount C-Channel

Module 4 p.12-17

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Installing Collectors

Module 4 p.19

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Roof Preparation

Anchoring into spanner

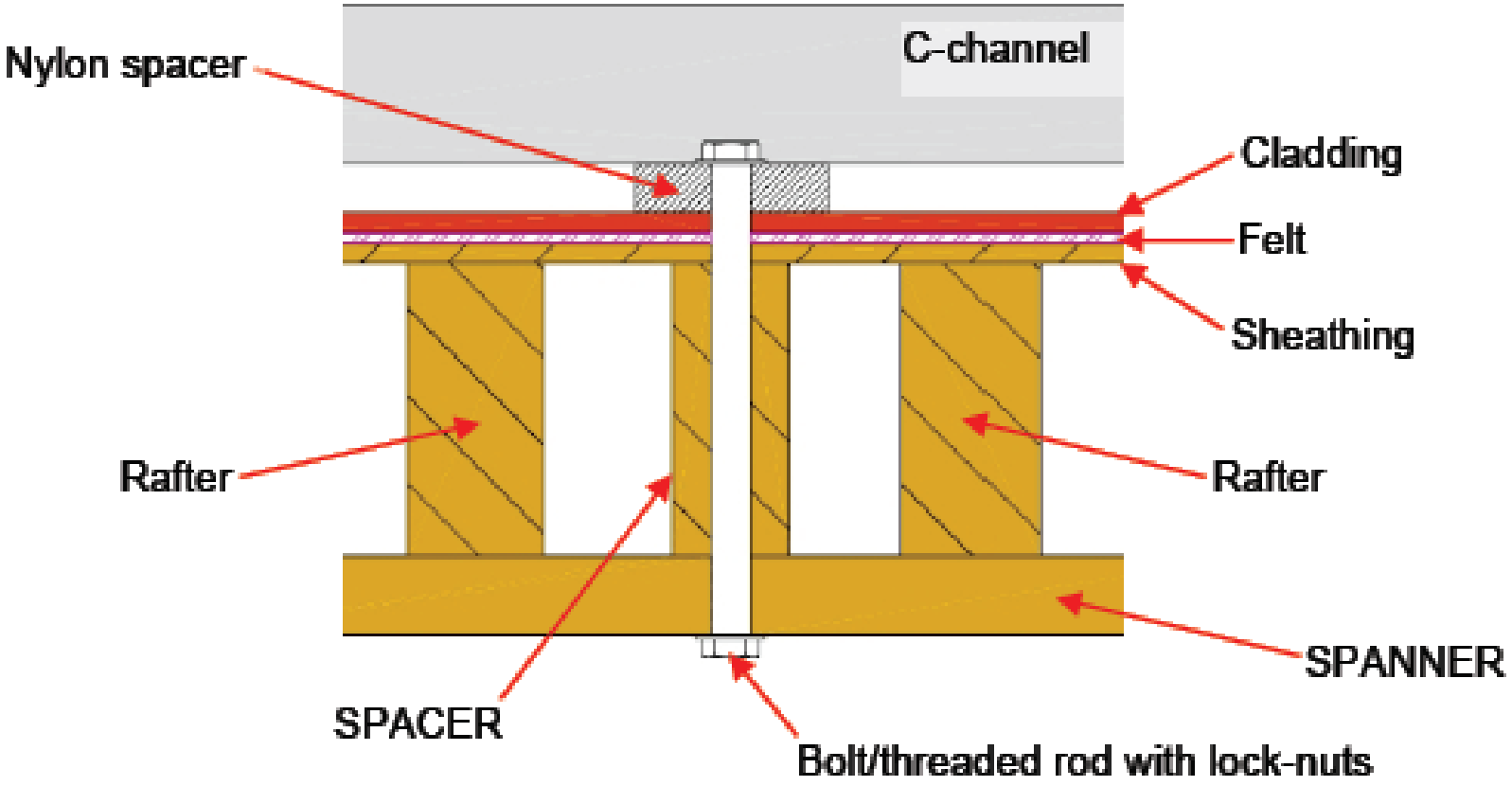

Fig.13 – C-channel secured to spanner

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J-bolts or U-bolts

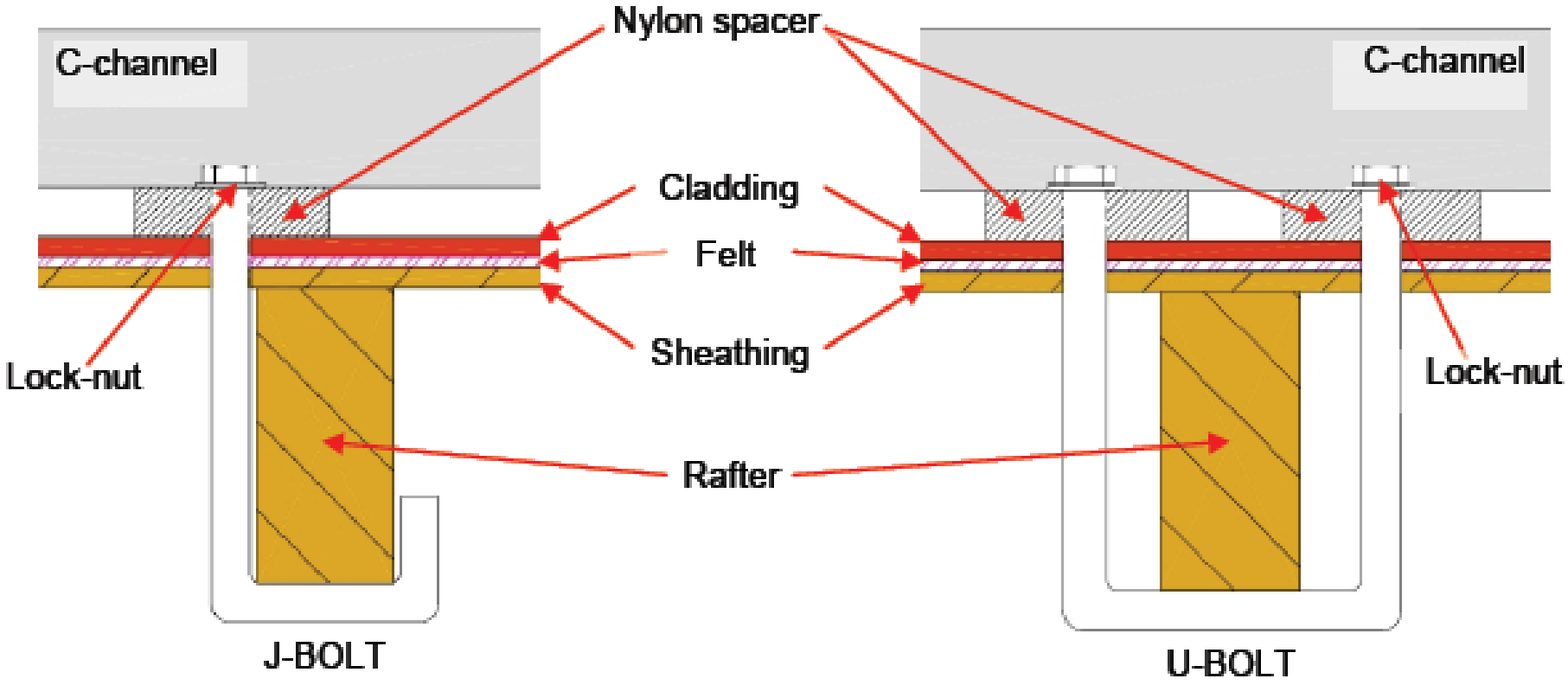

Fig.14 – C-channel secured to rafter with J-bolts and U-bolts

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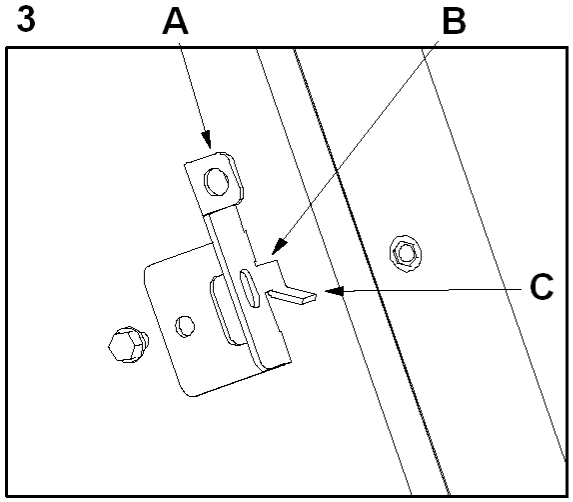
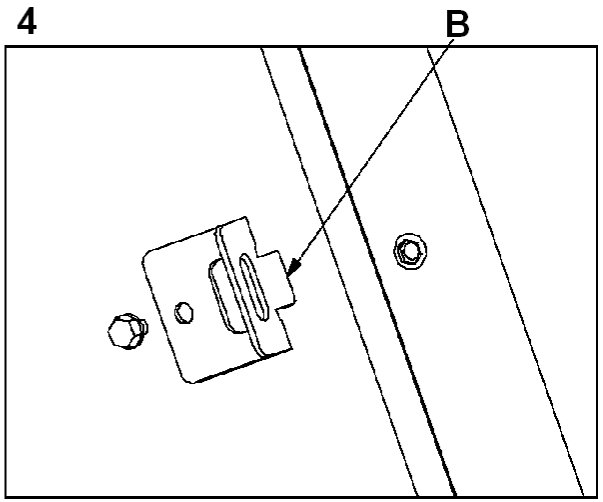
Roof penetration used as safety

Module 4 p.12-13

Preparation of Collectors – Mounting Brackets



Hook Mounting System
Upper Mounting Bracket



Hook Mounting System
Lower Mounting Bracket

Hook Bracket

A - Temporary lifting tab
B - Tab under collector edge – stops bracket swivel
C - Hook fits in C-channel to temporarily hold collector

L Bracket

Used for rack mounted collectors

Module 4 p.24-25

Preparation of Collectors – Thermistor installation

Install Thermistor by inserting between the absorber plate and the copper tubing

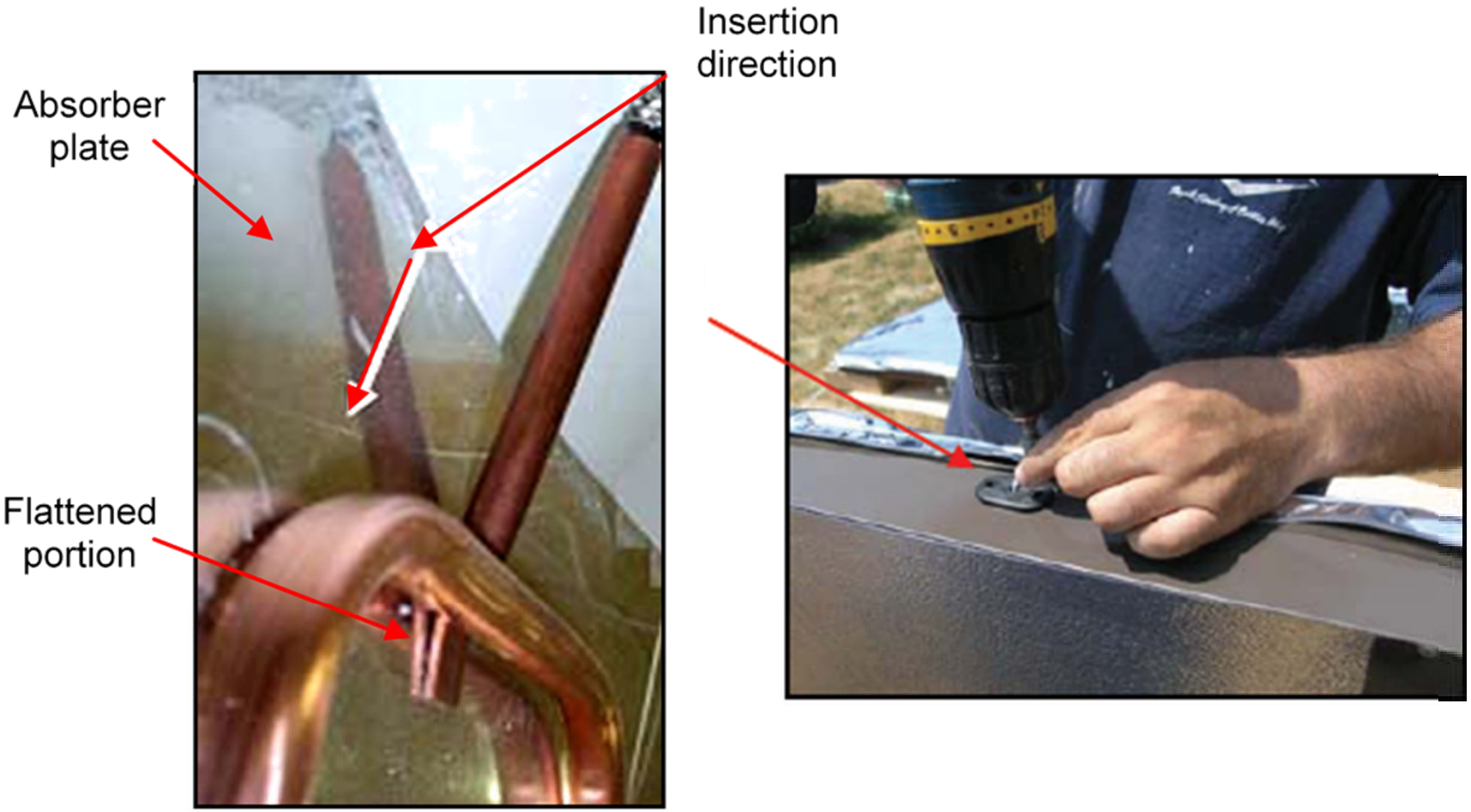


Fig.8.1.8 – Thermistor seated between absorber and tube.

Install Thermistor by inserting between the absorber plate and the copper tubing

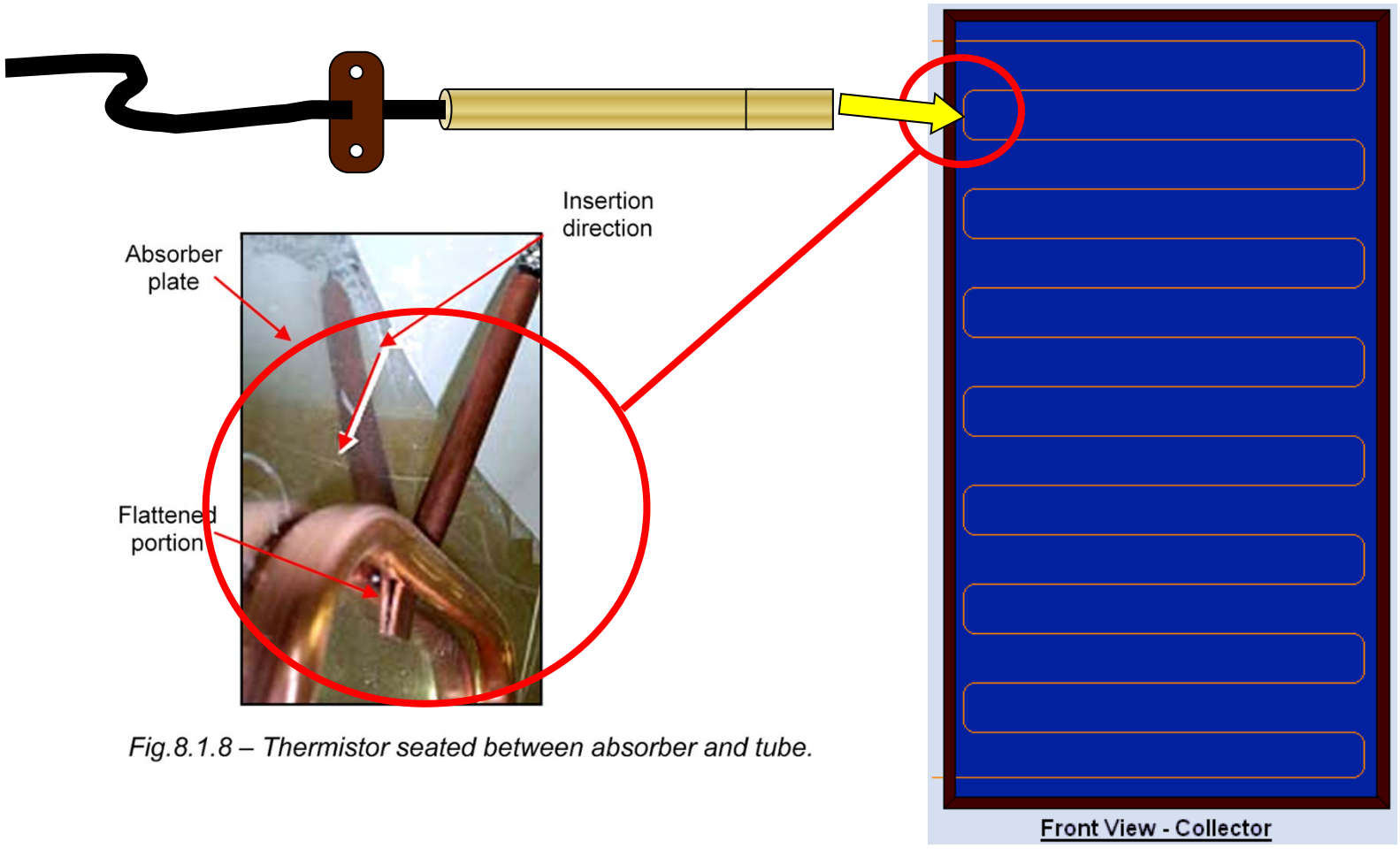


Fig.8.1.8 – Thermistor seated between absorber and tube.

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Preparation and Mounting of Collectors

- Install mounting brackets and temperature sensor (thermistor) in collector
- Lift collectors to roof
- Position first collector and secure
- Install connection fitting and align second collector
- Secure second collector

Module 4 p.23-30

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Collector lifts

Module 4 p.26

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Scaffolding

Fig.40 – Scaffolding used for lifting and as work platform

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Get help!

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Leave reflective foil in place to prevent flash boiling, scalding and damage to fluid

EnerWorks Line Set

- Plan route
- Length
- Wall/roof penetrations
- Control wire
- 3/8” refrigeration-grade flexible copper with flare-fittings

Module 4 p.9-11

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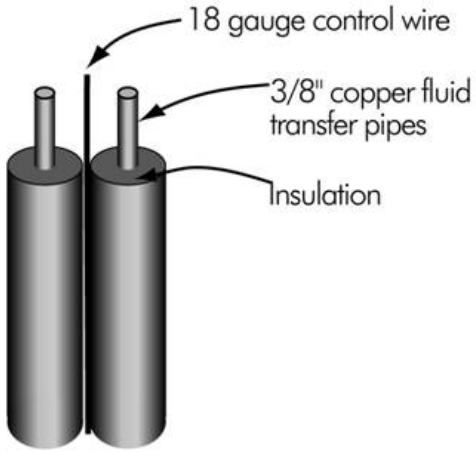
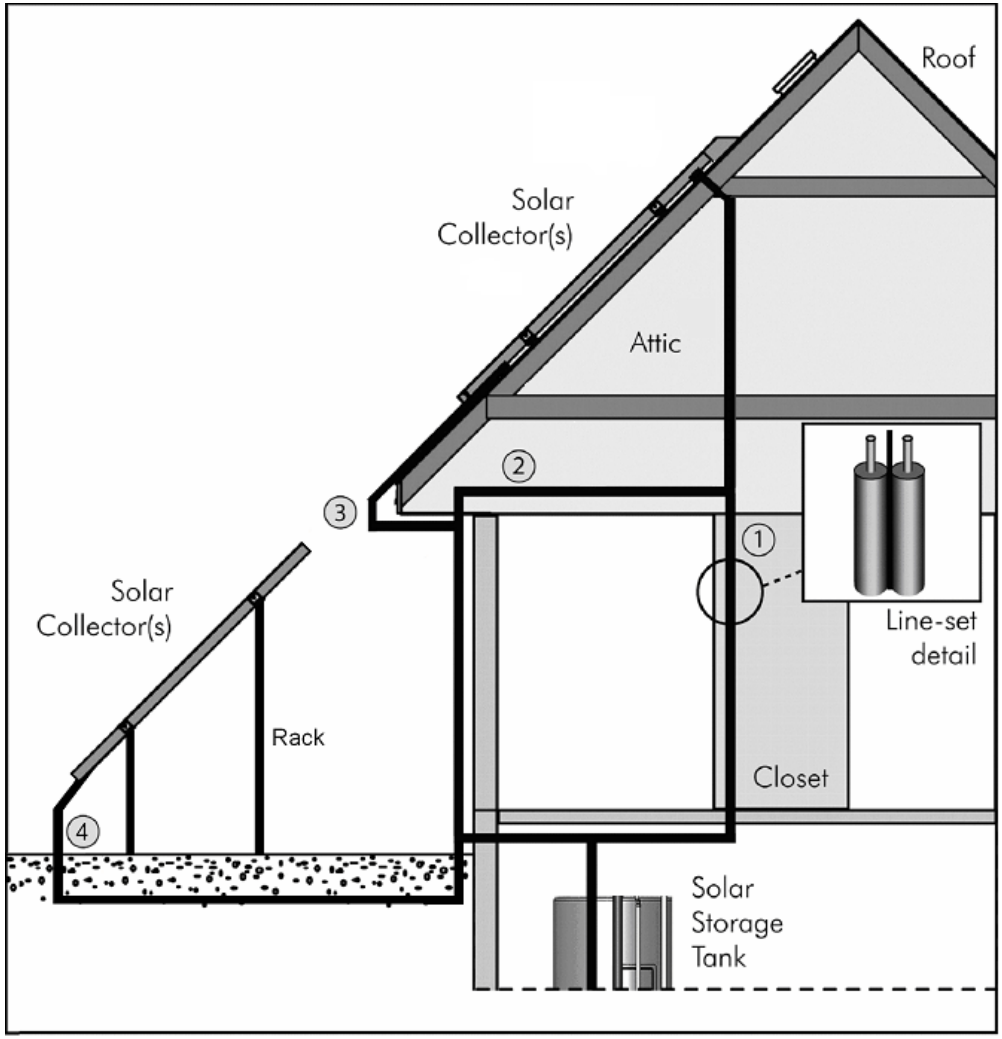
ENERGY KINETICS

Line Set Installation





Module 4 p.9

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Make line-set connections

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Questions?

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Module # 5

How it Works and Appliance Installation

Follow along with this module and page number in your training binder

Modules 1, 5,6 & 7

Slide presentation courtesy of Enerworks

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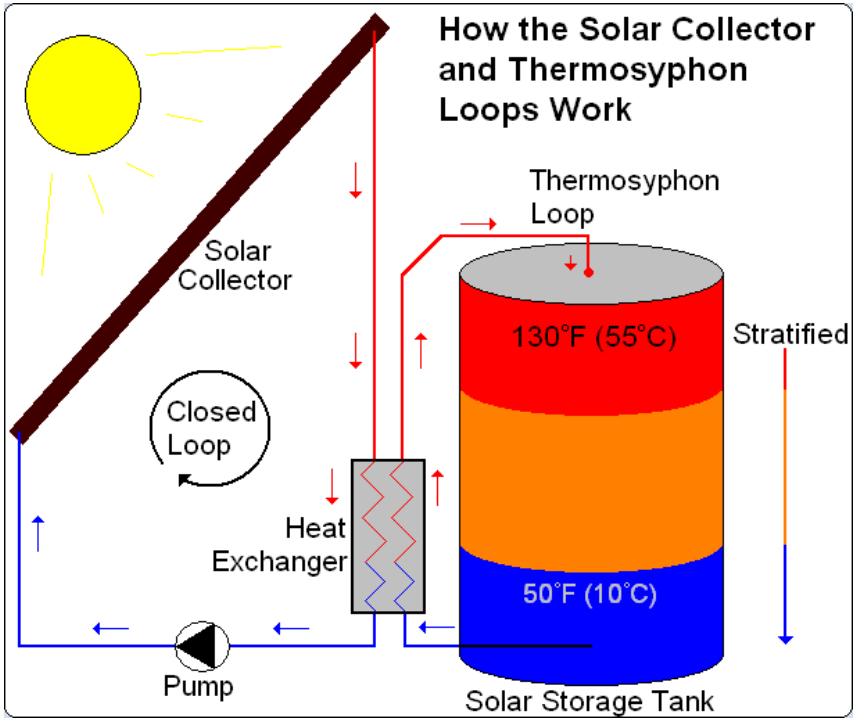
ENERGY KINETICS

How It Works

Solar Collector and
Thermosiphon Loops



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ENERGY KINETICS

Thermal stratification within the water tank

Y.M. Han, R.Z. Wang*, Y.J. Dai

"…energy storage efficiency and the whole system (efficiency) may be increased up to 6% and 20%, respectively."

"…thermal stratification has the effect of decreasing the temperature at the collector inlet which increases its efficiency and, on the other hand, of decreasing the periods of operation of the auxiliary energy supply, so improving efficiency is not only for the water tank, but also for the whole extended system."

"…mixing should be minimized in order to obtain maximum energy."

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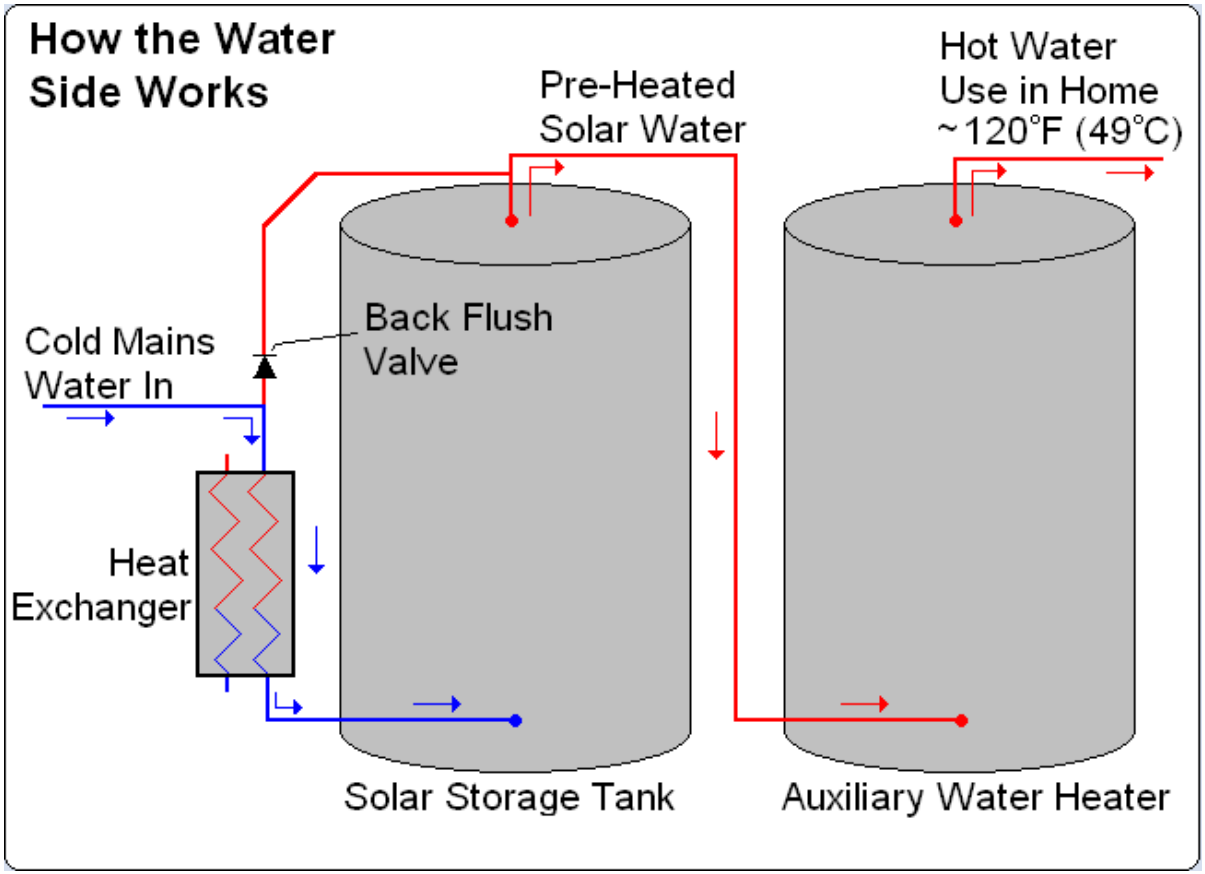
How It Works – The Water Side



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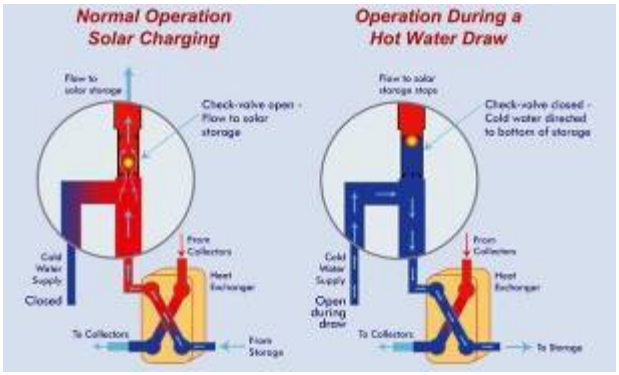
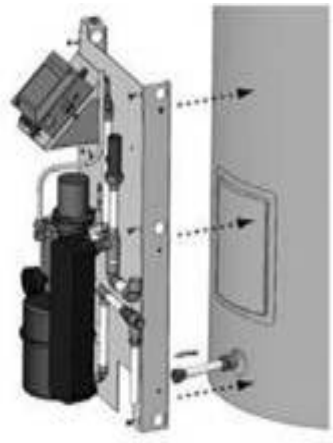
Patented, Proprietary Technology

BackFlush System



Strategic Implications:

- Enables heat exchanger system + energy pack design
- Dramatically increases system reliability
- Enables cost reduction (heat exchanger + standard hot water tank)
- Easier service and maintenance



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Back Flush System Testing

Fig. 5. Photo of the "baseline" heat exchanger at time of removal from the test rig.

Fig. 6. Comparison photo of the flow channels of the "baseline" heat exchanger (LHS) and the heat exchanger equipped with the passive back flow system (RHS) at the end of the testing period.

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Energy Pack with cover

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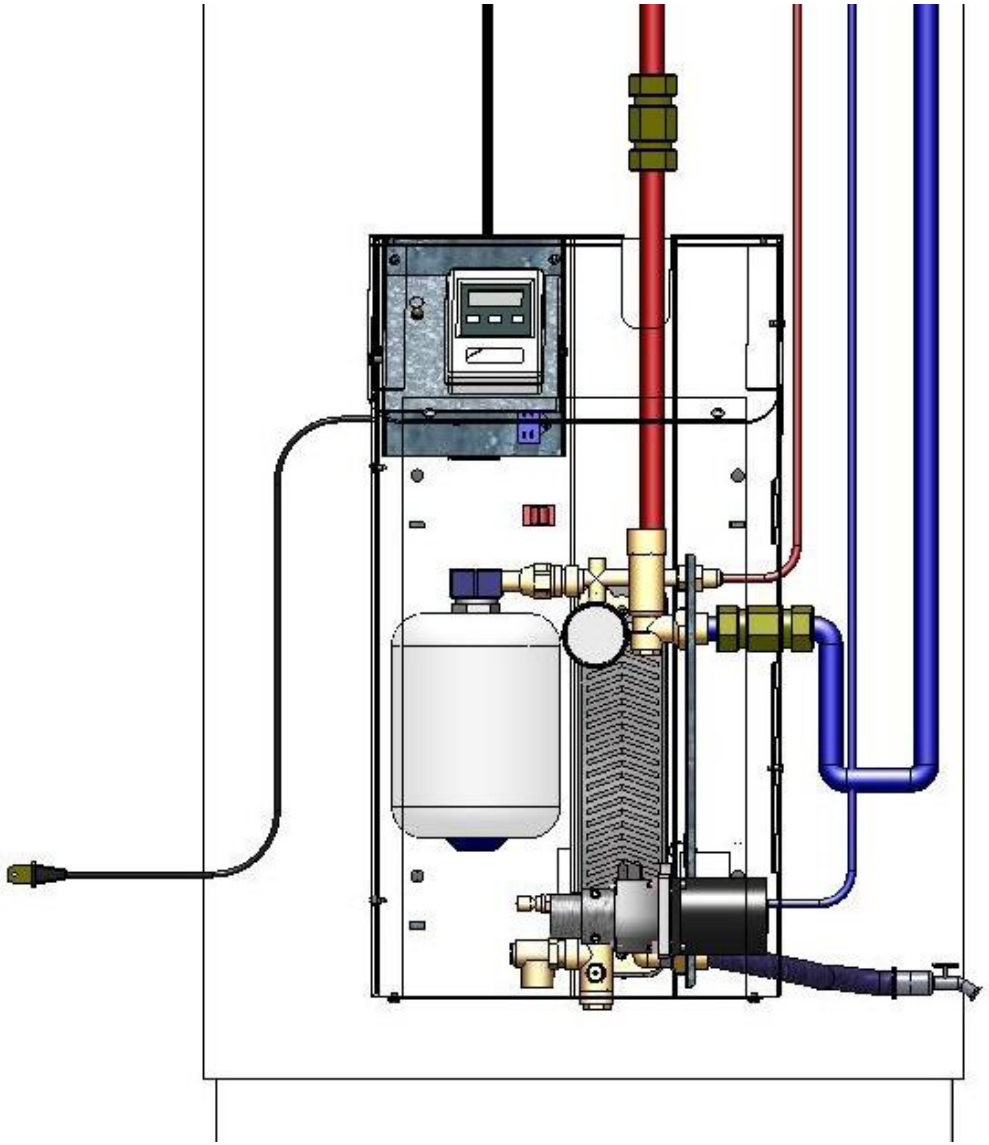
Energy Pack



Installing EnerWorks Energy Pack

- Turn water & power (or gas) off to existing tank and drain
- Position solar storage tank
- Mount energy pack to solar storage
- Plumb thermosiphon loop to solar storage
- Plumb solar to existing tank, adding by-pass
- Fill tanks
- Connect over temperature wire
- Turn power or gas back on

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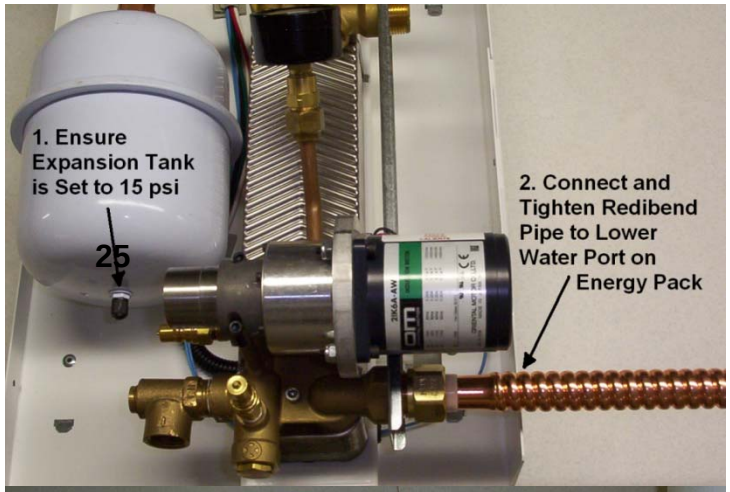
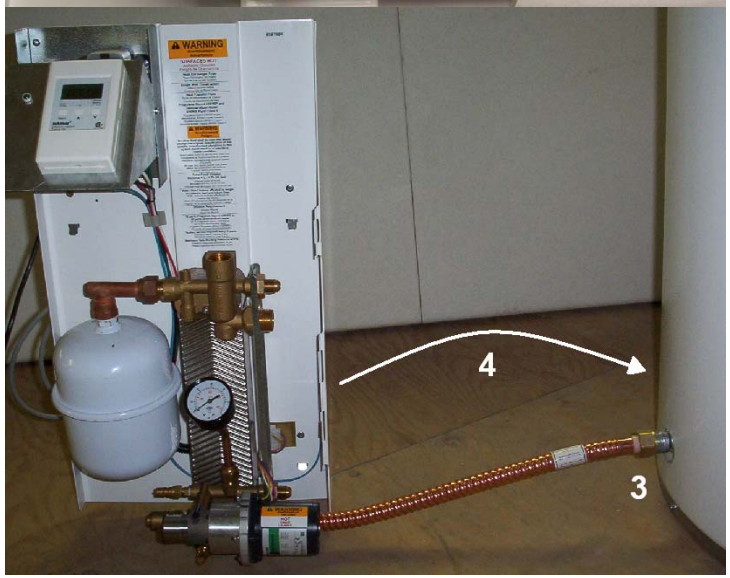
Mounting Energy Pack to Storage





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Plumb Energy Pack to Solar Storage

- Plumb thermosiphon loop – include union coupling?
- Plumb cold water in to Energy Pack (with heat-trap) – include union coupling?
- Plumb solar hot out into inlet of existing tank (existing tank should have heat-trap) – include union coupling?

Module 6 p.22

Space-Saver™ Thermosiphon Loop

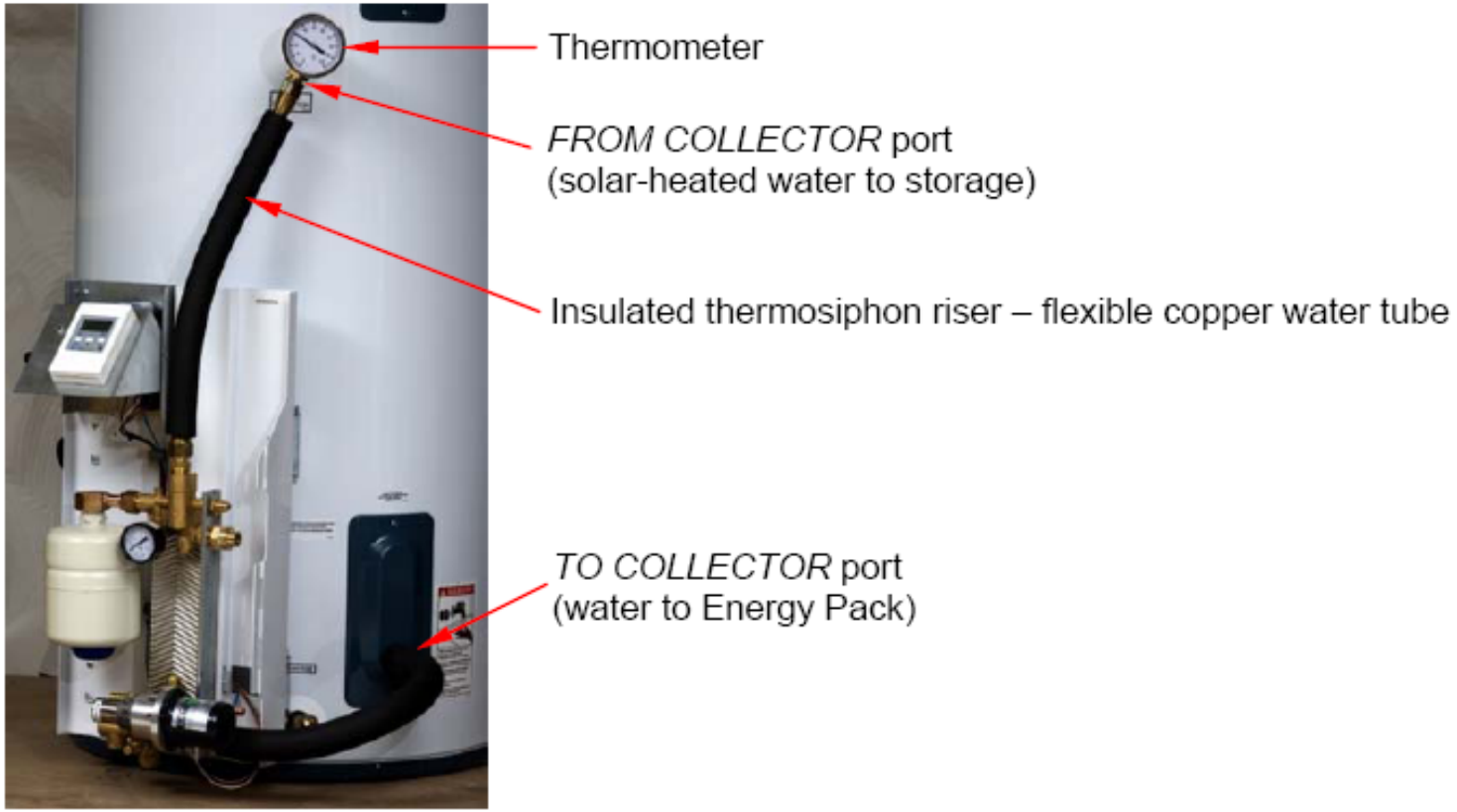


Fig.76 – Space-Saver (single-tank) Appliance thermosiphon loop

Cold mains inlet heat-trap

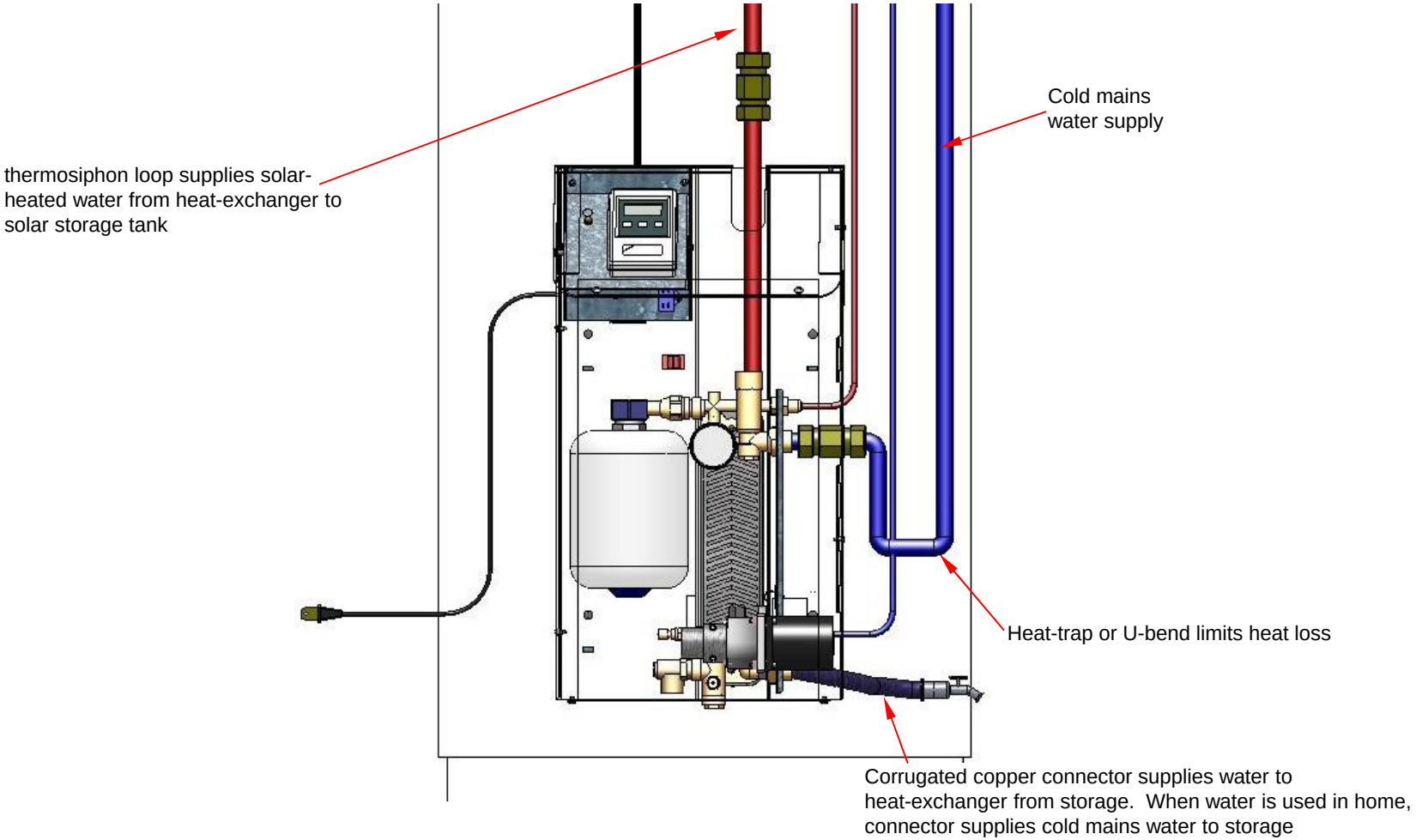
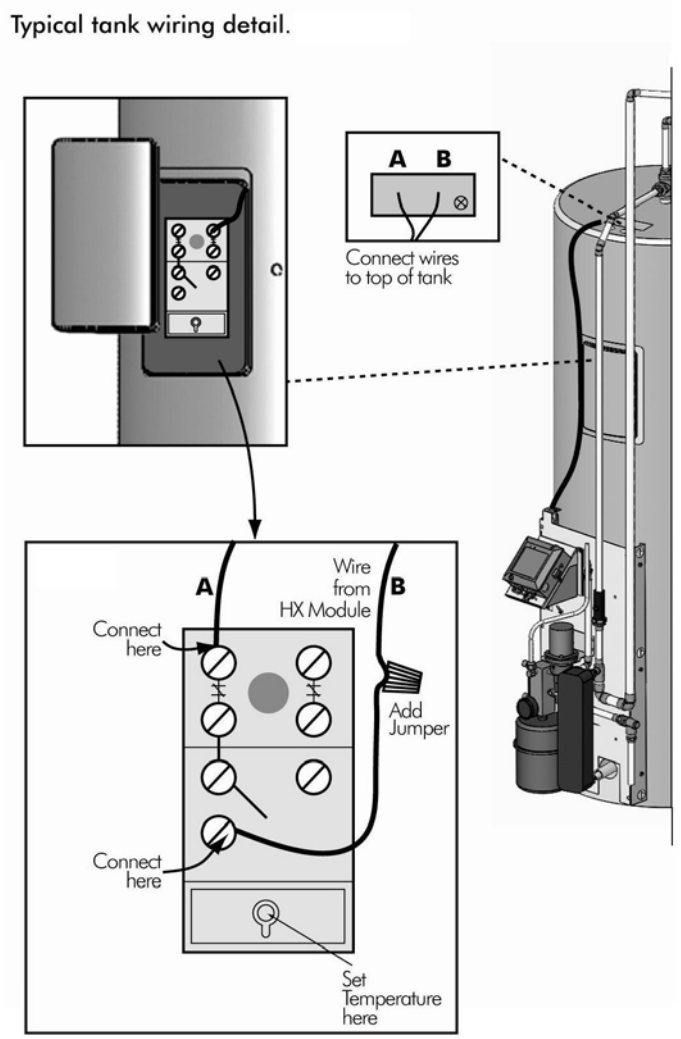


Fig.4.5.8 – Energy Pack water connections.

Over-temperature control

- Shuts system down when solar storage is fully loaded with heat
- Prevents boiling and limits scalding danger
- High Performance Appliance requires connection to storage tank's thermostat
- Space-Saver™ Appliance controller manages over-temperature control



Module 6 p.25-26

Controller connections

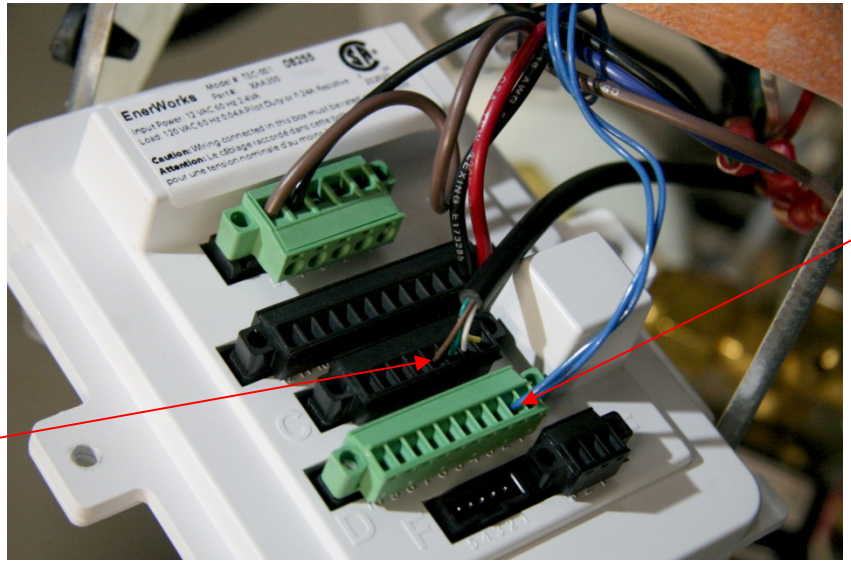


Fig.4.10.7 – Flow-meter wires connected to bank C. Thermistor wires connected to bank D.

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Testing and Charging

- Make line-set connections
- Pressurize expansion tank (25 psi)
- Pressure test with air (40 psi for 30 min)
- Insulate line-set connections
- Install collector flashing
- Charge appliance with fluid (purge air)
- Pressurize appliance (30 psi)

Module 6 p.30-31

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ENERGY KINETICS

Side-flashing for one collector

Upper section overlaps lower section for proper shedding of rain and snow

End-caps in place at top and bottom

Module 6 p.35

Center-flashing for multiple collectors

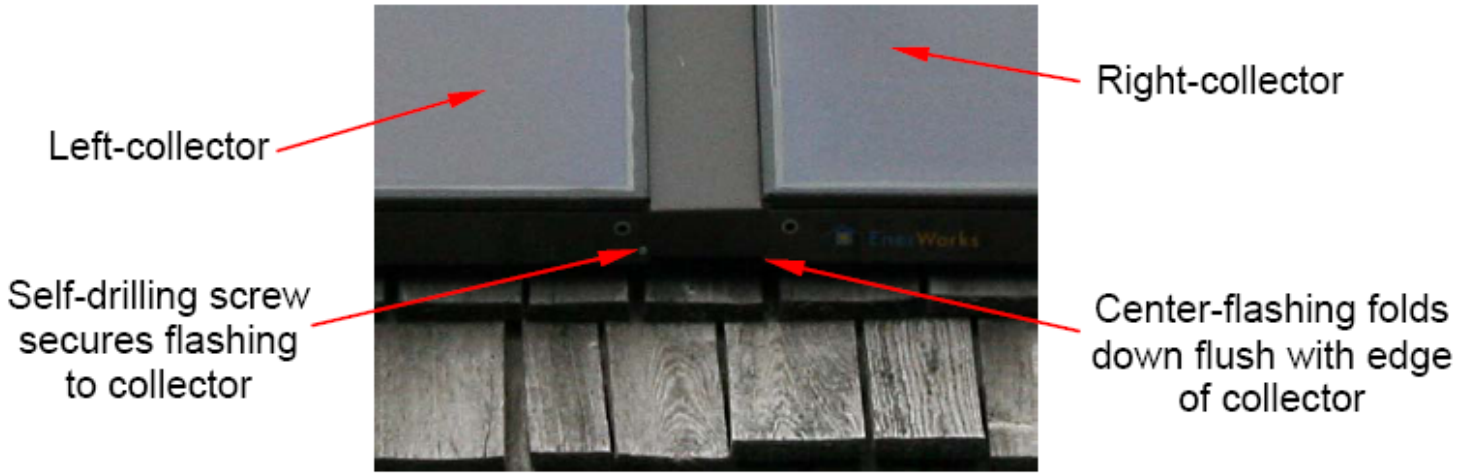

Fig.81 – Center-flashing folds down flush with edge of collector (2, 3 and 4-collector Appliances)

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ENERGY KINETICS

Center-flashing with leaf-guard

Center-flashing folded down and secured flush with leaf-guard

Fig.82 – Two collectors with center-flashing and leaf-guard

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Questions?

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Module # 5

How it Works and Appliance Installation

Follow along with this module and page number in your training binder

Modules 1, 5,6 & 7

Slide presentation courtesy of Enerworks

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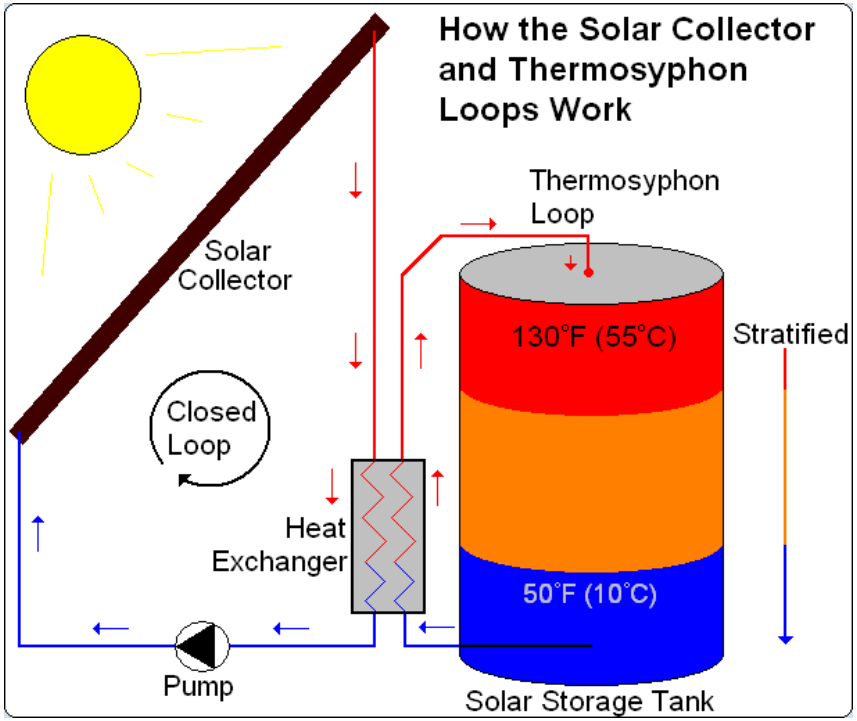
ENERGY KINETICS

How It Works

Solar Collector and
Thermosiphon Loops



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Thermal stratification within the water tank
Y.M. Han, R.Z. Wang*, Y.J. Dai

"…energy storage efficiency and the whole system (efficiency) may be increased up to 6% and 20%, respectively."

"…thermal stratification has the effect of decreasing the temperature at the collector inlet which increases its efficiency and, on the other hand, of decreasing the periods of operation of the auxiliary energy supply, so improving efficiency is not only for the water tank, but also for the whole extended system."

"…mixing should be minimized in order to obtain maximum energy."

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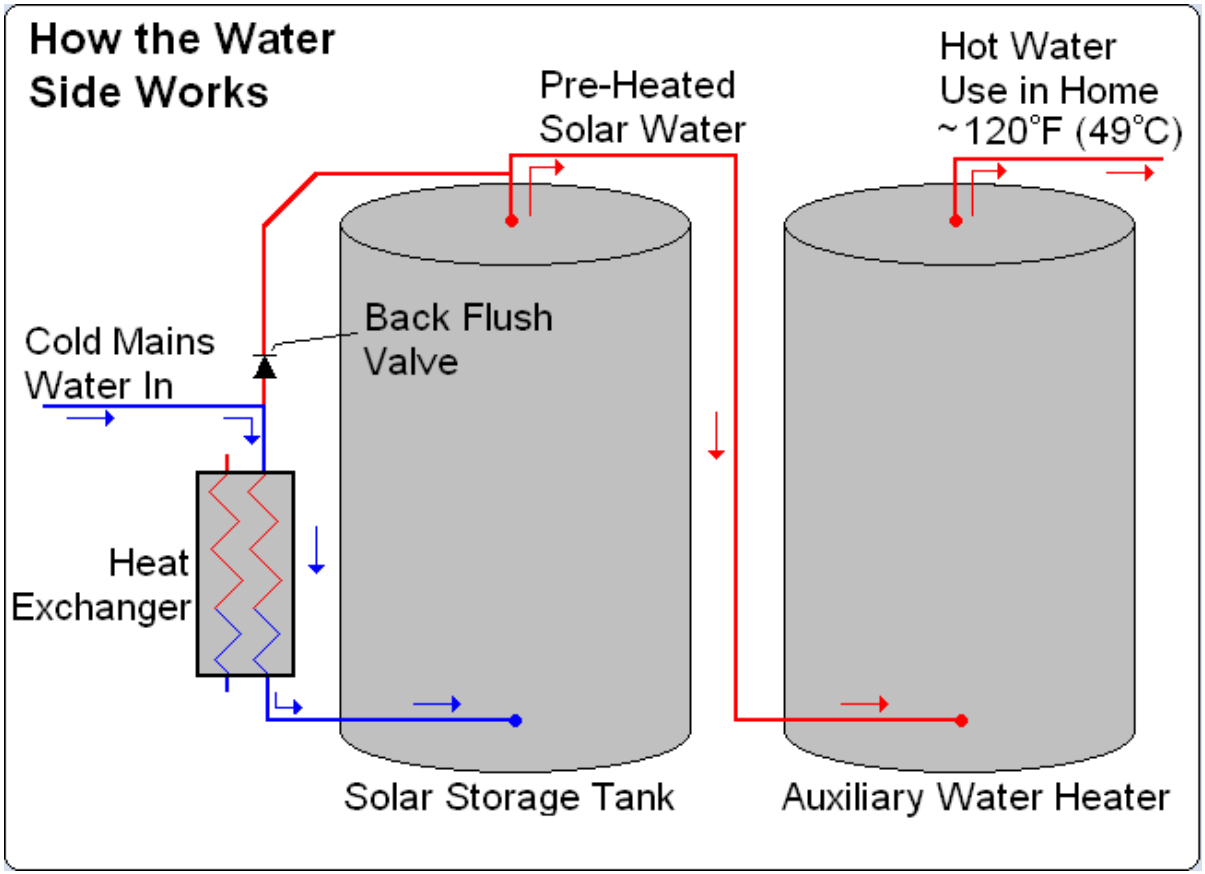
ENERGY KINETICS

How It Works – The Water Side



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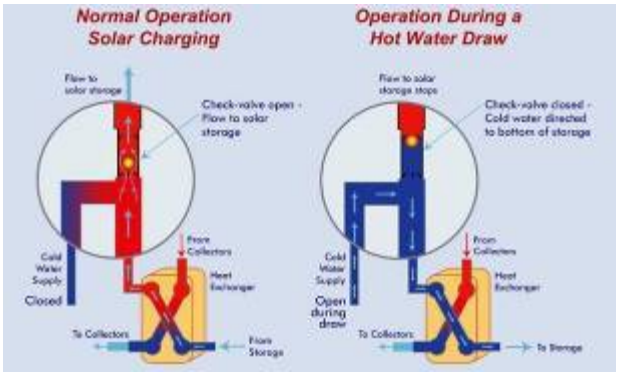
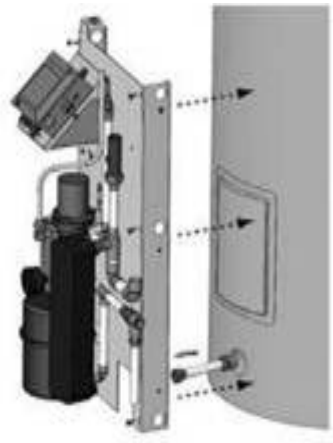
Patented, Proprietary Technology

BackFlush System



Strategic Implications:

- Enables heat exchanger system + energy pack design
- Dramatically increases system reliability
- Enables cost reduction (heat exchanger + standard hot water tank)
- Easier service and maintenance



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Back Flush System Testing

Fig. 5. Photo of the "baseline" heat exchanger at time of removal from the test rig.

Fig. 6. Comparison photo of the flow channels of the "baseline" heat exchanger (LHS) and the heat exchanger equipped with the passive back flow system (RHS) at the end of the testing period.

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Energy Pack with cover

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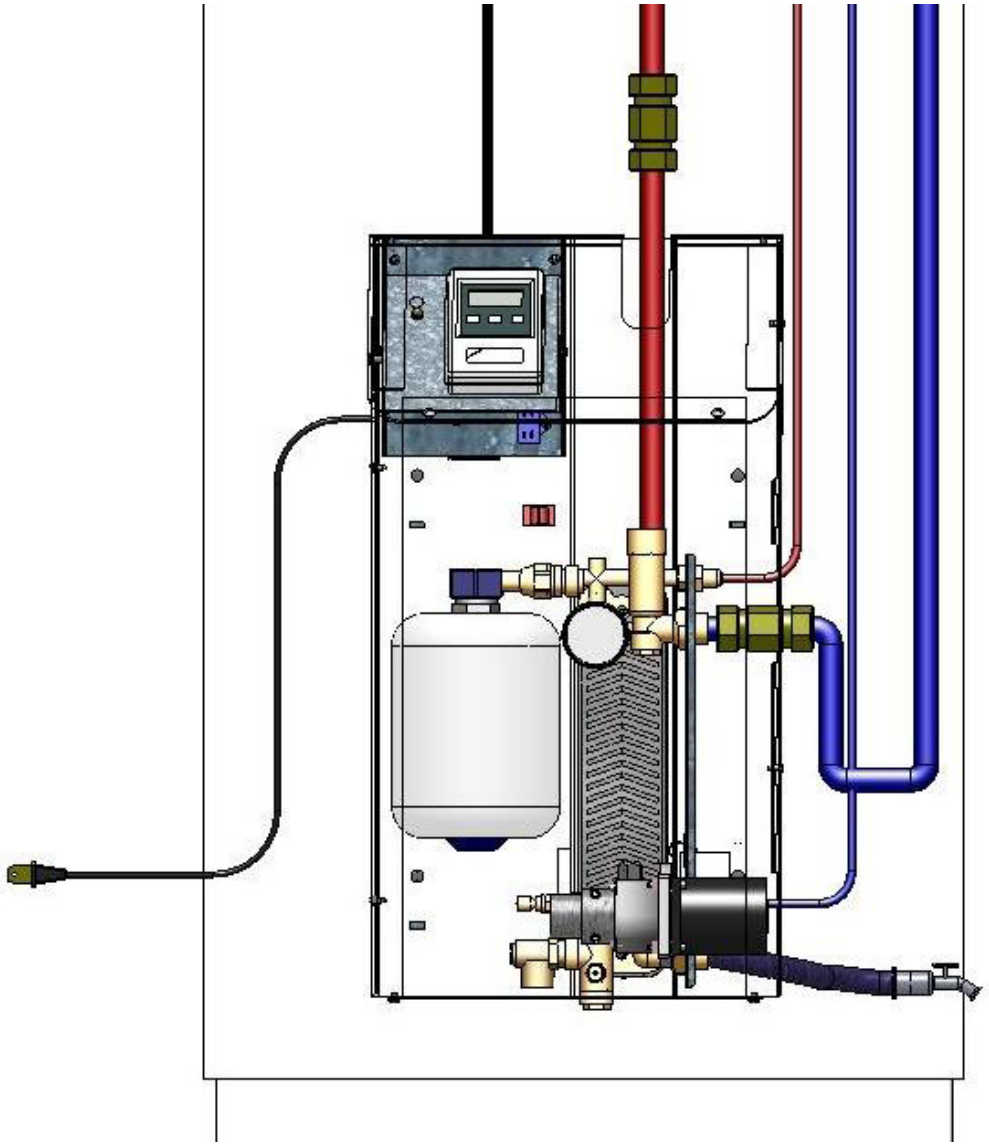
Energy Pack



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Installing EnerWorks Energy Pack

- Turn water & power (or gas) off to existing tank and drain
- Position solar storage tank
- Mount energy pack to solar storage
- Plumb thermosiphon loop to solar storage
- Plumb solar to existing tank, adding by-pass
- Fill tanks
- Connect over temperature wire
- Turn power or gas back on

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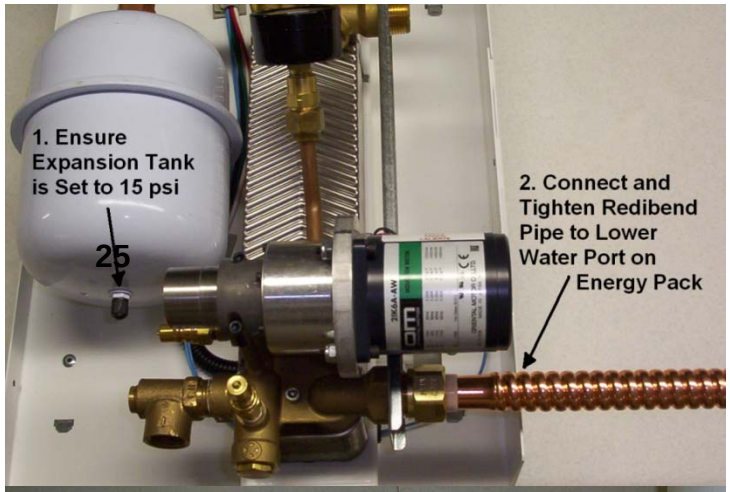
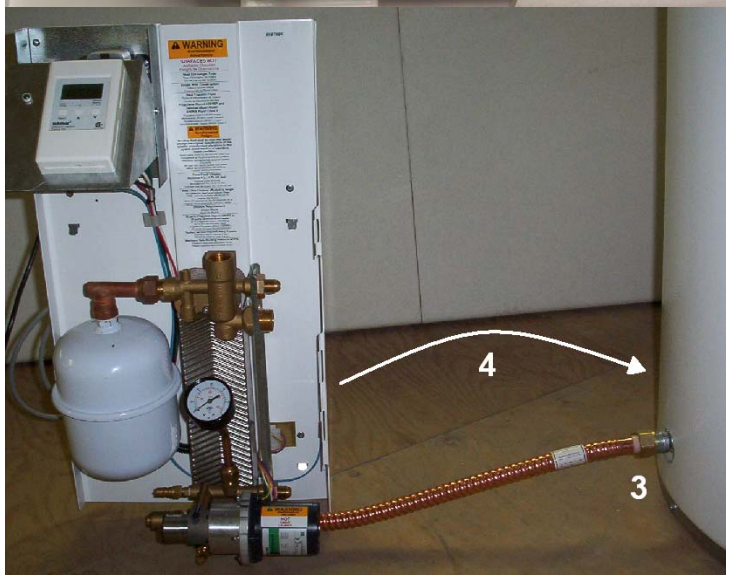
Mounting Energy Pack to Storage





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Plumb Energy Pack to Solar Storage

- Plumb thermosiphon loop – include union coupling?
- Plumb cold water in to Energy Pack (with heat-trap) – include union coupling?
- Plumb solar hot out into inlet of existing tank (existing tank should have heat-trap) – include union coupling?

Cold mains inlet heat-trap

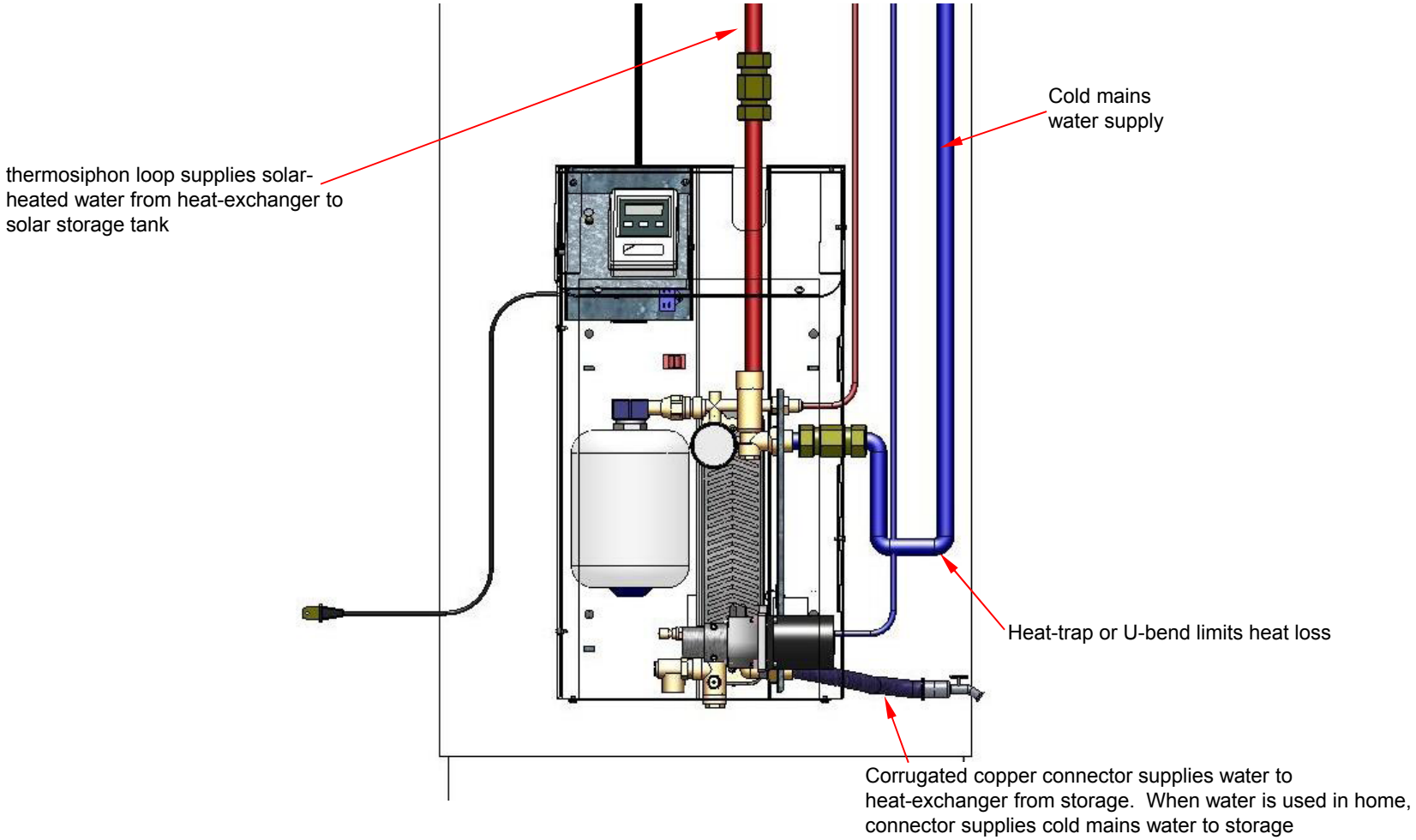

Fig.4.5.8 – Energy Pack water connections.

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- High Performance Appliance requires connection to storage tank's thermostat
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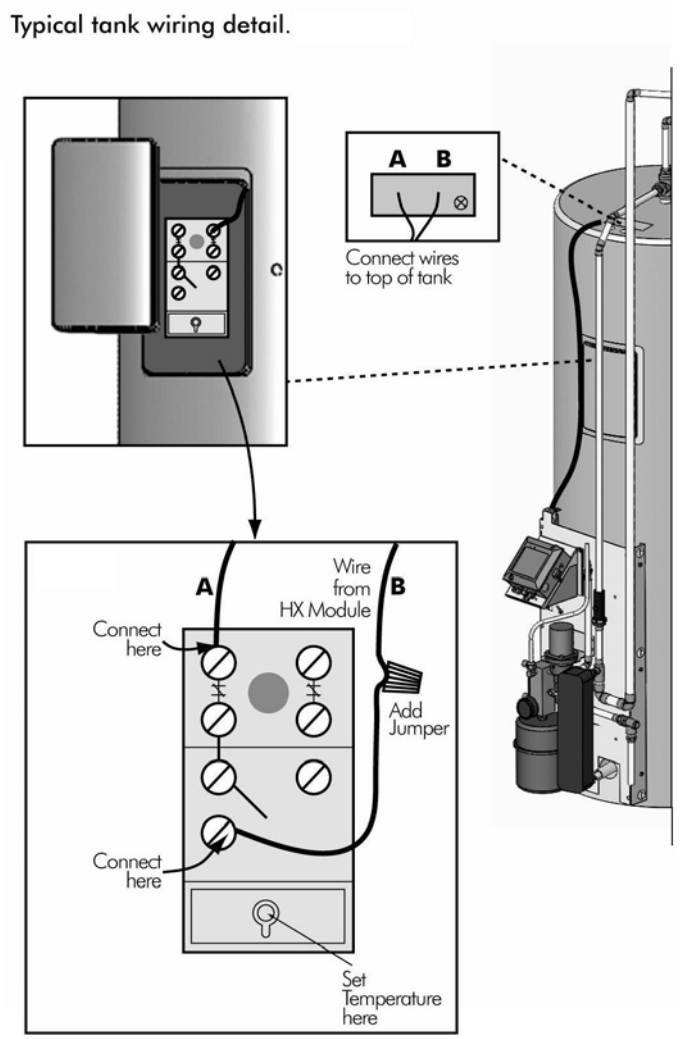

Module 6 p.25-26

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Testing and Charging

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- Pressurize expansion tank (25 psi)
- Pressure test with air (40 psi for 30 min)
- Insulate line-set connections
- Install collector flashing
- Charge appliance with fluid (purge air)
- Pressurize appliance (30 psi)

Module 6 p.30-31

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ENERGY KINETICS

Side-flashing for one collector

Upper section overlaps lower section for proper shedding of rain and snow

End-caps in place at top and bottom

Module 6 p.35

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Center-flashing for multiple collectors

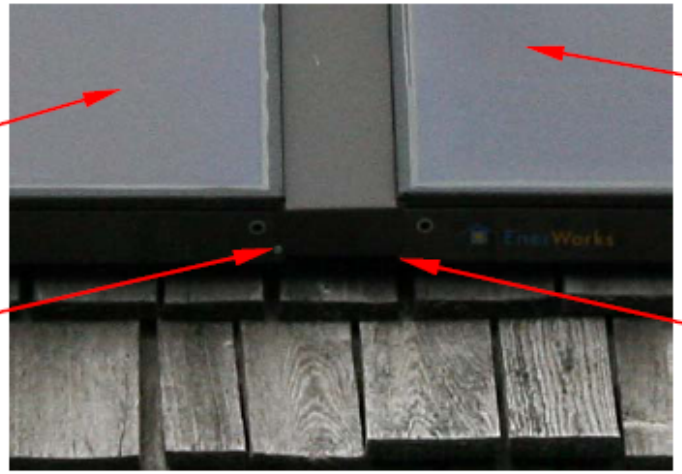

Fig.81 – Center-flashing folds down flush with edge of collector (2, 3 and 4-collector Appliances)

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Center-flashing with leaf-guard

Center-flashing folded down and secured flush with leaf-guard

Fig.82 – Two collectors with center-flashing and leaf-guard

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Module # 6

Appliance Control Wire Connections

Follow along with this module and page number in your training binder

Installation Manual

Slide presentation courtesy of Enerworks

Energy Station Wire Connections

Note that line voltage is pre-wired to outlet plug and the pump is pre-wired in the Energy Pack.

1. Double check control wire connections and collector thermistor resistance with an ohmmeter.

2. Wire Energy Station – it is possible wire from the back.

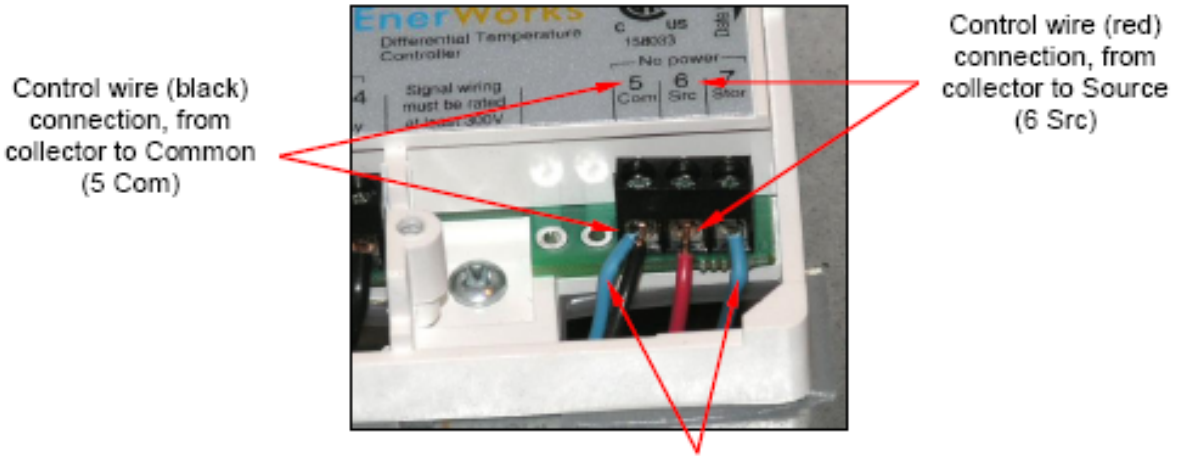
3. Remove Controller “snap-on” cover by unscrewing. Lift so the controller is horizontal.

4. Wire into lower right opening of Controller.

Control with cover removed

Installation Manual p. 32

Controller Thermistor Connections



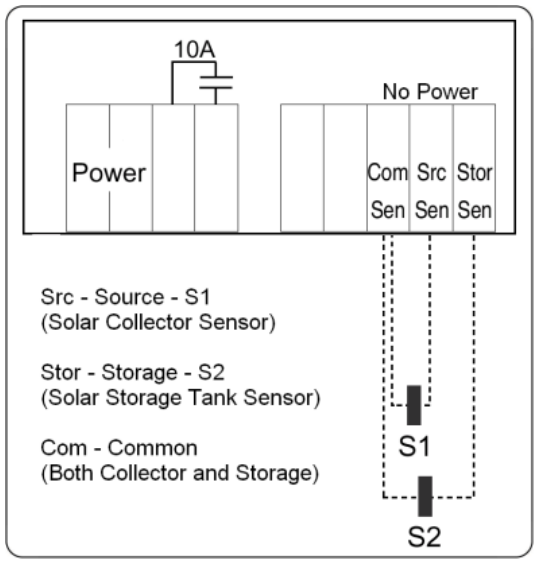


Fig.4.11.2 – Controller thermistor connections

5. Replace “snap-on” cover and push Controller assembly down.
6. Temporarily plug in Energy Station. LCD screen default display is temperature difference (ΔT) between Source (collector) and Storage (bottom of solar storage tank).
   - If ΔT is displayed, thermistor and control wires are connected correctly.
   - If an error signal flashes (Err), check display for whether it is a Source (collector) or Storage (tank) error.
7. If thermistors are connected correctly, unplug Energy Station.

Installation Manual p. 32 & p. 49

Leak Test with Air – 30 Minutes

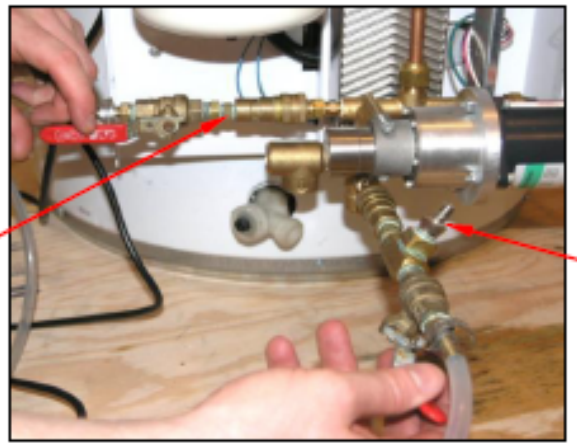
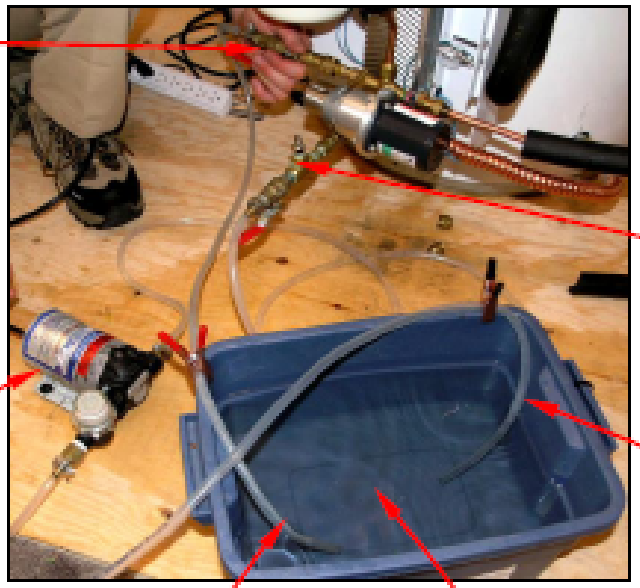


Fig.5.1.1 – Charge Kit supply and return assemblies.

Fig.5.1.2 – Leak-test: pressurize appliance to 40 psi and wait 30 minutes.

Installation Manual p. 33

Charge with 50/50 Propylene Glygol & Distilled Water



KEY POINTS:

- **Expansion tank air pressure set to 25 psi.**
- **System fluid pressure set to 30 psi.**
- **Air must be completely purged from system.**

Fig.5.3.1 – Charging Kit and fluid reservoir

Installation Manual p. 34 – 35

Purge Air from System

*Collectors must remain covered until charging is complete!

1) Connect Charge pump – flow is only a few feet per second, so it may take a few minutes to flow through the entire system.
   - Note: If fluid is immediately discharging, ensure Energy Station pump is not turning, short circuiting the collector loop.
2) Purge Air from inside expansion tank
   - Allow charge pump to pressurize to 40psi by closing ball valve.
   - Quickly open valve to allow pressure to drop to 0 psi, discharging air
   - Repeat (3) times to ensure clear
3) Purge air from Energy Station Pump
   - When off, gear pump acts as a check valve
   - Plug in Energy Station and run pump for 10 seconds
   - If solar panel is less than 18°F hotter than tank, run pump with the following method (next slide)

Installation Manual p. 34 – p. 36

Manually Run Energy Pack Pump

Fig.5.3.2 – Manually start pump by pushing all three buttons to enter program (PRGM) mode then push down button. To shut off, enter PRGM mode and push up button.

a) Hold all three Controller buttons down until it enters program mode (*Fig. 5.3.2*).
b) Screen should read “AU”; this is default automatic setting. Press down (right) button once; screen will switch to “ON” (*Fig. 5.3.2*).
c) Wait for 20 seconds. Controller exits program mode and Energy Station pump will start, clearing pump of air.
d) Let pump run for 10 seconds and then unplug Energy Station.

- An alternative is to apply a 4.5-5 kΩ resistor to Source and Common terminals at bottom right of Controller, under cover. This will simulate a hot collector and unit should turn on.

Installation Manual p. 36

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Questions?

Module # 6

Controller and Monitor

Follow along with this module and page number in your training binder

Module 6

Slide presentation courtesy of Enerworks

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Digital Controller & Monitor

kWh or **BTU**

Solar energy delivered

CO_2

CO_2 avoided

$ savings

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Energy Monitoring

Home Data Centre

EnerWorks
Thermal Energy Controller

802.15.4
wireless
protocol

Thermal
Energy
Monitor

Utilities'
Data
Server

SMART SOLAR™
ENERGY KINETICS

- Wireless remote operation
- Consumer friendly read-out
- Display options include:
  - ✓Dollars saved
  - ✓Energy produced
  - ✓Carbon reduction

SMART SOLAR™
ENERGY KINETICS

Wireless Monitor

kWh or **BTU**

Solar energy delivered

CO_2

CO_2 avoided

$ savings

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Please see Module 8 of
the EnerWorks Training Binder
for Detailed Instructions on the
Programming of the EnerWorks
Thermal Energy Controller (TEC)
and
Thermal Energy Monitor (TEM)

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Questions?

Module # 7
Summary, Warranty and Incentives

Follow along with this module and page number in your training binder

Module

Slide presentation courtesy of Enerworks

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Residential Market in Canada

$1 Bn/yr potential

Two segments:

- ~ 150,000 new homes/yr
  - Highest penetration rate due to lower installation costs

$50 Bn potential

- ~ 10 M existing homes
  - Every home needs a new hot water heater or new roof ~ every 20 years
    - 500,000 possible customers each year

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EnerWorks Solar Water Heating Appliance

- Flat-plate
- Indirect, closed-loop
- Food-grade, freeze-protected heat-transfer fluid
- High-performance (pre-heat) and Space-Saver™ (single-tank) solutions
- Digital differential temperature controller
- Over-temperature control
- Integrated stagnation control
- SRCC / IAPMO / FSEC / CSA certifications

232023

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Certifications

SRCC / FSEC / IAPMO / CSA certifications

232023

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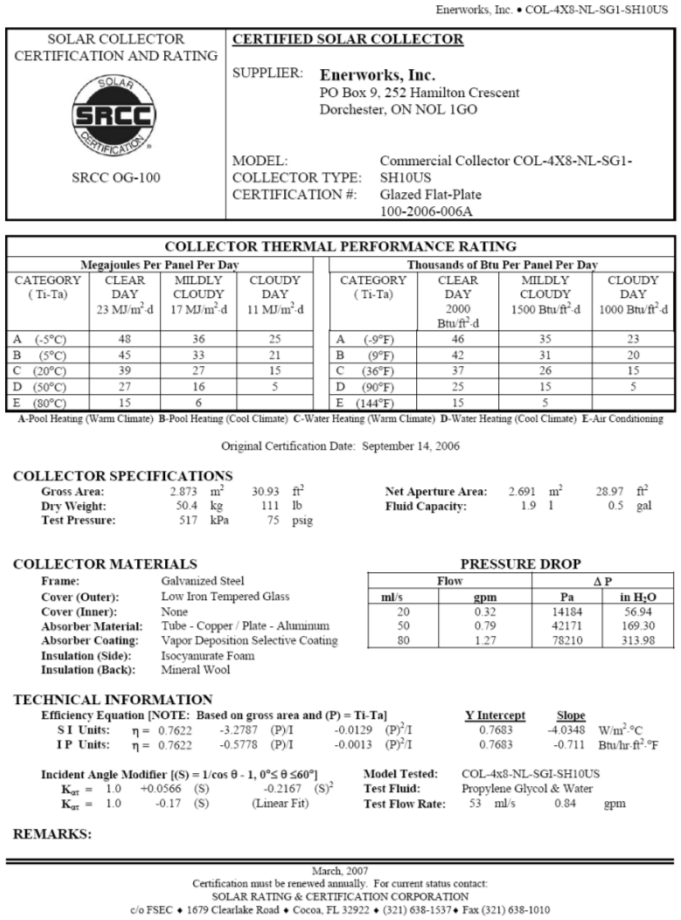
Certification

- **SRCC**
- Solar Rating and Certification Corporation
  www.srcc.org

- OG-100 Collector rating
- OG-300 Full appliance rating

- **FSEC**
- Florida Solar Energy Center
  www.fsec.ucf.edu



Enerworks, Inc. • COL-4X8-NL-SG1-SH10US

SOLAR COLLECTOR CERTIFICATION AND RATING

SRCC OG-100

CERTIFIED SOLAR COLLECTOR

SUPPLIER: **Enerworks, Inc.**
PO Box 9, 252 Hamilton Crescent
Dorchester, ON NOL 1GO

MODEL: Commercial Collector COL-4X8-NL-SG1-
COLLECTOR TYPE: SH10US
CERTIFICATION #: Glazed Flat-Plate
100-2006-006A

COLLECTOR THERMAL PERFORMANCE RATING

	Megajoules Per Panel Per Day				Thousands of Btu Per Panel Per Day			
	CATEGORY (Ti-Ta)	CLEAR DAY 23 MJ/m²·d	MILDLY CLOUDY 17 MJ/m²·d	CLOUDY DAY 11 MJ/m²·d	CATEGORY (Ti-Ta)	CLEAR DAY 2000 Btu/ft²·d	MILDLY CLOUDY 1500 Btu/ft²·d	CLOUDY DAY 1000 Btu/ft²·d
A	(-5°C)	48	36	25	(-9°F)	46	35	23
B	(5°C)	45	33	21	(9°F)	42	31	20
C	(20°C)	39	27	15	(36°F)	37	26	15
D	(50°C)	27	16	5	(90°F)	25	15	5
E	(80°C)	15	6		(144°F)	15	5	

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

Original Certification Date: September 14, 2006

COLLECTOR SPECIFICATIONS

Gross Area:	2.873	m²	30.93	ft²	**Net Aperture Area:**	2.691	m²	28.97	ft²
Dry Weight:	50.4	kg	111	lb	**Fluid Capacity:**	1.9	l	0.5	gal
Test Pressure:	517	kPa	75	psig					

COLLECTOR MATERIALS

Frame:	Galvanized Steel
Cover (Outer):	Low Iron Tempered Glass
Cover (Inner):	None
Absorber Material:	Tube - Copper / Plate - Aluminum
Absorber Coating:	Vapor Deposition Selective Coating
Insulation (Side):	Isocyanurate Foam
Insulation (Back):	Mineral Wool

PRESSURE DROP

Flow		ΔP	
ml/s	gpm	Pa	in H_2O
20	0.32	14184	56.94
50	0.79	42171	169.30
80	1.27	78210	313.98

TECHNICAL INFORMATION

Efficiency Equation [NOTE: Based on gross area and (P) = Ti-Ta]

						Y Intercept	Slope	
S I Units:	η =	0.7622	-3.2787	(P)/I	-0.0129 (P)²/I	0.7683	-4.0348	W/m²·°C
I P Units:	η =	0.7622	-0.5778	(P)/I	-0.0013 (P)²/I	0.7683	-0.711	Btu/hr·ft²·°F

Incident Angle Modifier [(S) = 1/cos θ - 1, 0°≤ θ ≤60°]

$K_{\alpha\tau}$ =	1.0	+0.0566 (S)	-0.2167 (S)²	
$K_{\alpha\tau}$ =	1.0	-0.17 (S)	(Linear Fit)	

Model Tested: COL-4x8-NL-SGI-SH10US
Test Fluid: Propylene Glycol & Water
Test Flow Rate: 53 ml/s 0.84 gpm

REMARKS:

March, 2007
Certification must be renewed annually. For current status contact:
SOLAR RATING & CERTIFICATION CORPORATION
c/o FSEC ♦ 1679 Clearlake Road ♦ Cocoa, FL 32922 ♦ (321) 638-1537♦ Fax (321) 638-1010

SMART SOLAR™
ENERGY KINETICS

Certified by CSA International

CSA INTERNATIONAL

Certificate of Compliance

Certificate:	1721596	**Master Contract:**	232023
Project:	1721596	**Date Issued:**	2006/11/08

Issued to: **EnerWorks Inc**
252 Hamilton Cres
Dorchester, ON N0L 1G0
Canada
Attention: Florin Plavosin

The products listed below are eligible to bear the CSA Mark shown

Issued by: T. Lu

Authorized by: Nick Alfano, Operations Manager

SMART SOLAR™
ENERGY KINETICS

Certified by IAPMO – USEC

IAPMO RESEARCH AND TESTING, INC.

5001 East Philadelphia Street, Ontario, California 91761-2816 • (909) 472-4100 Fax (909) 472-4244 • www.iapmo.org

ANSI Accredited Program
PRODUCT CERTIFICATION

IAPMO R&T

USEC

CERTIFICATE OF LISTING

IAPMO Research and Testing, Inc. is a product certification body which tests and inspects samples taken from the supplier's stock or from the market or a combination of both to verify compliance to the requirements of applicable codes and standards. This activity is coupled with periodic surveillance of the supplier's factory and warehouses as well as the assessment of the supplier's Quality Assurance System. This listing is subject to the conditions set forth in the characteristics below and is not to be constructed as any recommendation, assurance or guarantee by IAPMO Research and Testing, Inc. of the product acceptance by Authorities Having Jurisdiction.

Effective Date: January 2008 Void After: January 2009

Product: Water Heaters Solar (Thermosyphon)

Issued To: Enerworks Inc. File No. S-5423

Warranty

- Ten-year limited warranty on collectors
- Five-year limited warranty on Energy Pack
- Two-year on electrical parts in Energy Pack (pump + controller)
- Product Issue Assessment Form to be filled out including serial numbers – complete Product and Installation Registration Form
- Distributor and Dealers should maintain inventory of spare parts

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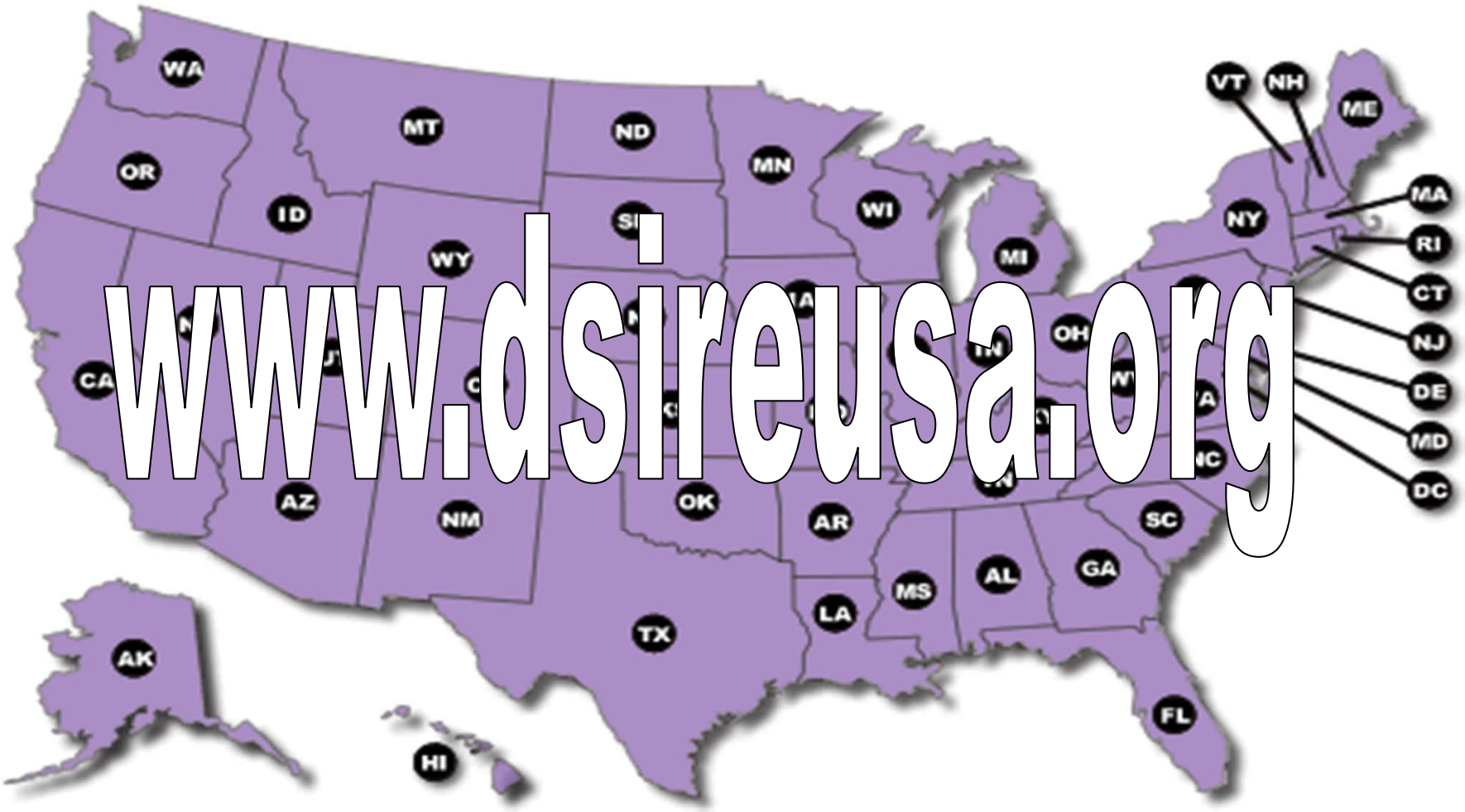

www.dsireusa.org

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- **www.enerworks.com** – EnerWorks
- **www.aceee.org** – American Council for an Energy-Efficient Economy
- **www.dsireusa.org** –
  Database of State Incentives for Renewables & Efficiency
- **www.eia.doe.gov** – Energy Information Administration
- **www.energytaxincentives.org**
- **www.seia.org** & **www.nmsea.org** – Solar Energy Associations
- **www.cleanenergynm.org**

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Installation Pictures

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2 Panel Solar water-heating – Model Home – Mattamy Homes Milton Ont.

MATTAMY homes

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3 Panel Solar Heating Integrated with Geothermal – Mattamy Homes Model Home Milton Ontario

MATTAMY homes

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Roof-integrated collectors – Marshall Homes Copperfield Development Oshawa Ontario

MARSHALL HOMES
solar+ at work
COPPERFIELD
HOMES of LASTING CHARACTER

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Questions?

Module # 8

Introduction to Commercial

Follow along with this module and page number in your training binder

Module 8

Slide presentation courtesy of Enerworks

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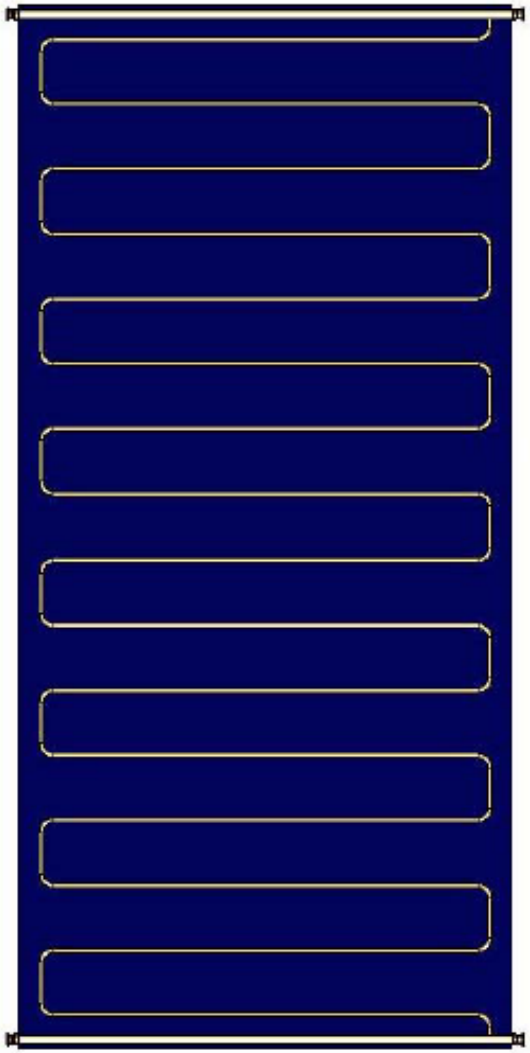
COMMERCIAL COLLECTOR

- Serpentine Flow
- ¾” headers
- 4’X8’
- Portrait Mount
- Galvalume Frame
- No Temp. Limiting Device
- 110 lb dry – 113 lb wet
- Silicon Bonded Construction



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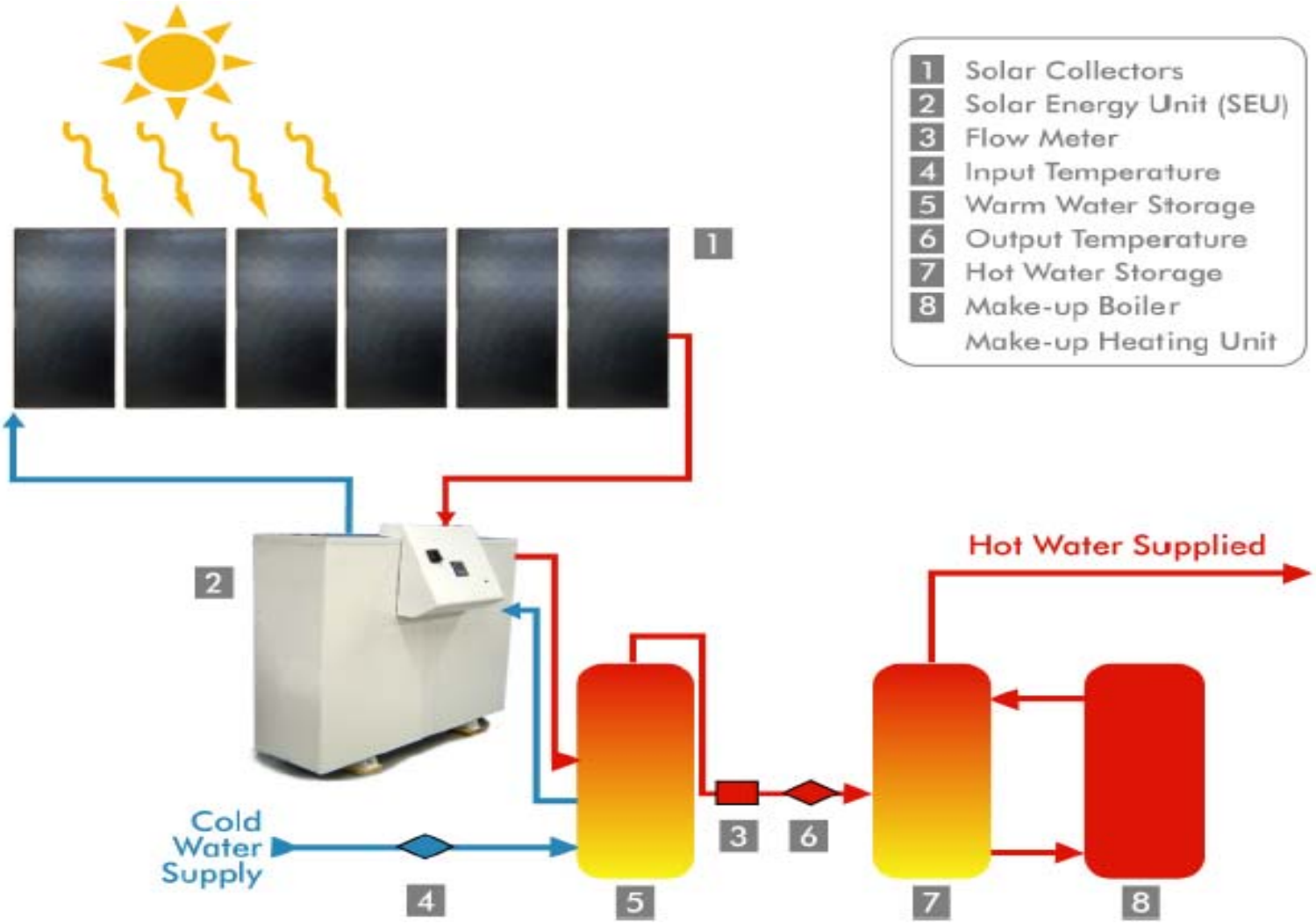

SMART SOLAR™
ENERGY KINETICS

COMMERCIAL COLLECTORS - CONNECTORS

SMART SOLAR™
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Top-rated solar thermal collector
Certified by independent agencies

SOLAR RATING AND CERTIFICATION CORPORATION

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

OG-100

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Up to 10 collectors in parallel

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Solar Energy Unit
6 sizes from:
20 to 150
collectors

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SOLAR ENERGY UNIT (SEU), 6 SIZES

SEU Model	# of Collectors
• **40 kW_{th}**	<= 20
• **80 kW_{th}**	21 - 40
• **100 kW_{th}**	41 - 50
• **160 kW_{th}**	51 - 80
• **200 kW_{th}**	81 - 100
• **300 kW_{th}**	101 - 150

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SOLAR ENERGY UNIT

- *Integrated solution*
- *Intelligent controls*
- *Pre-assembled*
- *Daily valve exercising*
- *Brazed-plate heat exchanger*
- *Automatic back flush*
- *Factory tested*
- *Quick installation*

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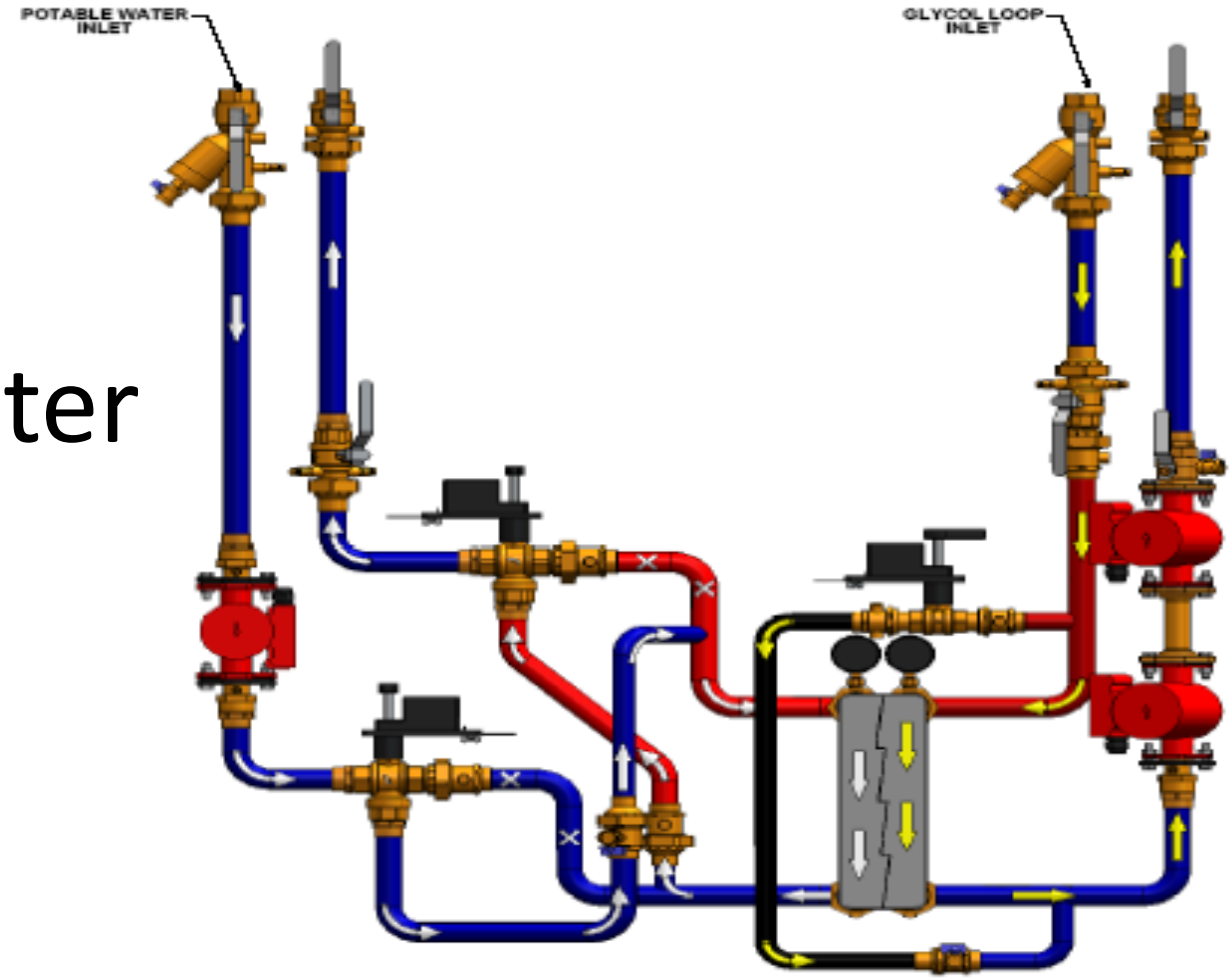
Water



HT Fluid

POTABLE FLOW
HEAT EXCHANGER BACKFLUSH
BACK FLUSH VALVES OPENED

GLYCO FLOW
WITH COLD START
BYPASS OPENED

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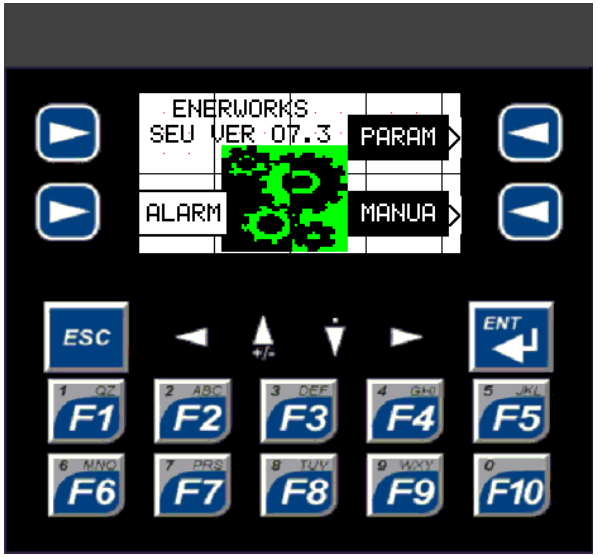
CONTROLLER

- Differential temperature control
- Back Flush control for cleaning of the waterside heat exchanger
- Pump Soft Start
- Alarms
- Some Data Logging



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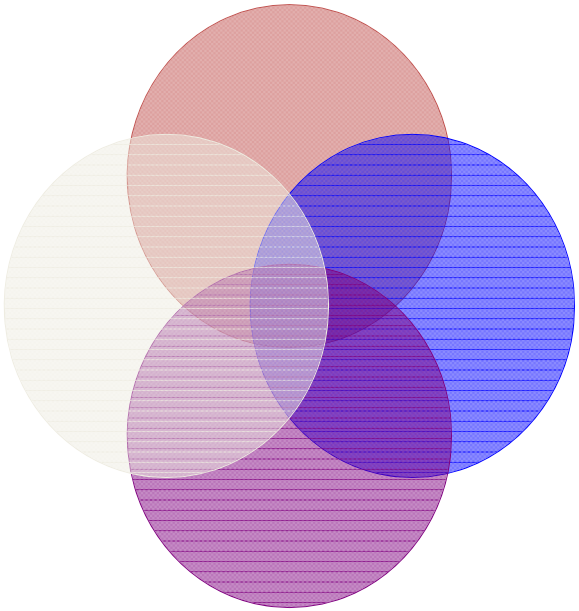
TURN KEY VALUE PROPOSITION

Scalable Collector Modules

Solar
Energy Unit



Fast, Quality
Installation

Control Logic
Integrates with Building Systems

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ENGINEERING INPUTS REQUIRED

- Location (incl. building code and rebate requirements)
- Roof lay-out and construction
- Apartments/Beds/Guests Rooms/Occupants, etc.
- Application (Domestic Hot Water, Pool Heating, Space or Process Heating)
- Current Heating System (BTU/H, Storage, fuel, Temp. Settings)
- Mechanical Room Lay-out
- Drawings, if available
- Usage Profile (daily, weekly, yearly)
- Contacts

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LOAD MEASURING/ESTIMATING

- BTU Meter
- Flow Meter
- ASHRAE Table
- Flow Usage Estimates/Bucket
- Energy/Water Usage

dynasonics

eesiflo

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SOME RULES OF THUMB

- Installed Cost - $3500 to $4000 pre grants, tax credit etc per collector
- Storage of 20 Gallons per collector
- ASHRAE #'s

Nursing Homes	18.4 gal/Bed
Apartments	40 gal/Unit
Basic Hotel	14 gal/Room

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Installation Pictures

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WILLIAM FREMD HIGH SCHOOL, CHICAGO

General Energy

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HOSPITAL FOR SICK CHILDREN, TORONTO

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FRITO LAY CORPORATE, DALLAS AREA

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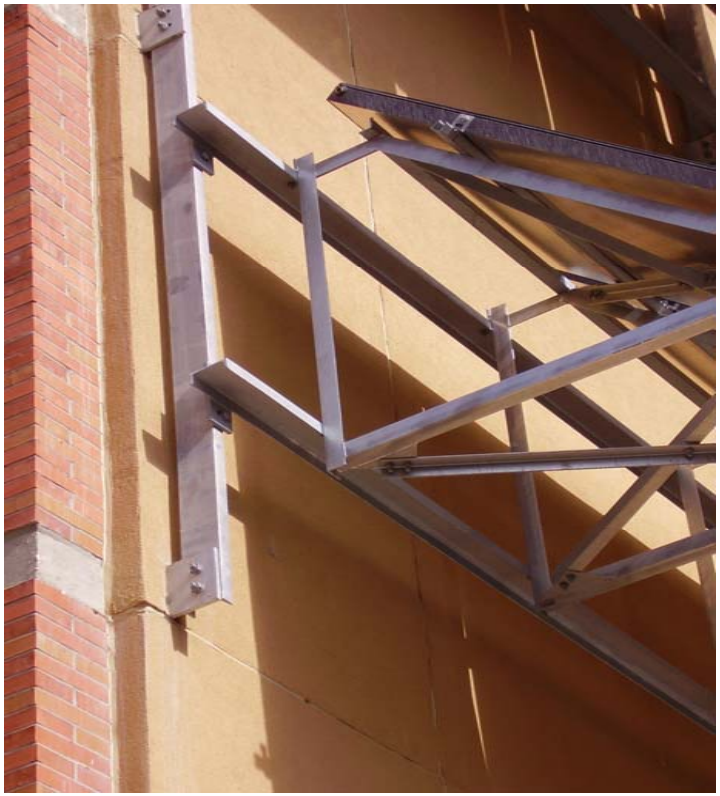
GREEN PHOENIX – SOLAR + GEO-THERMAL



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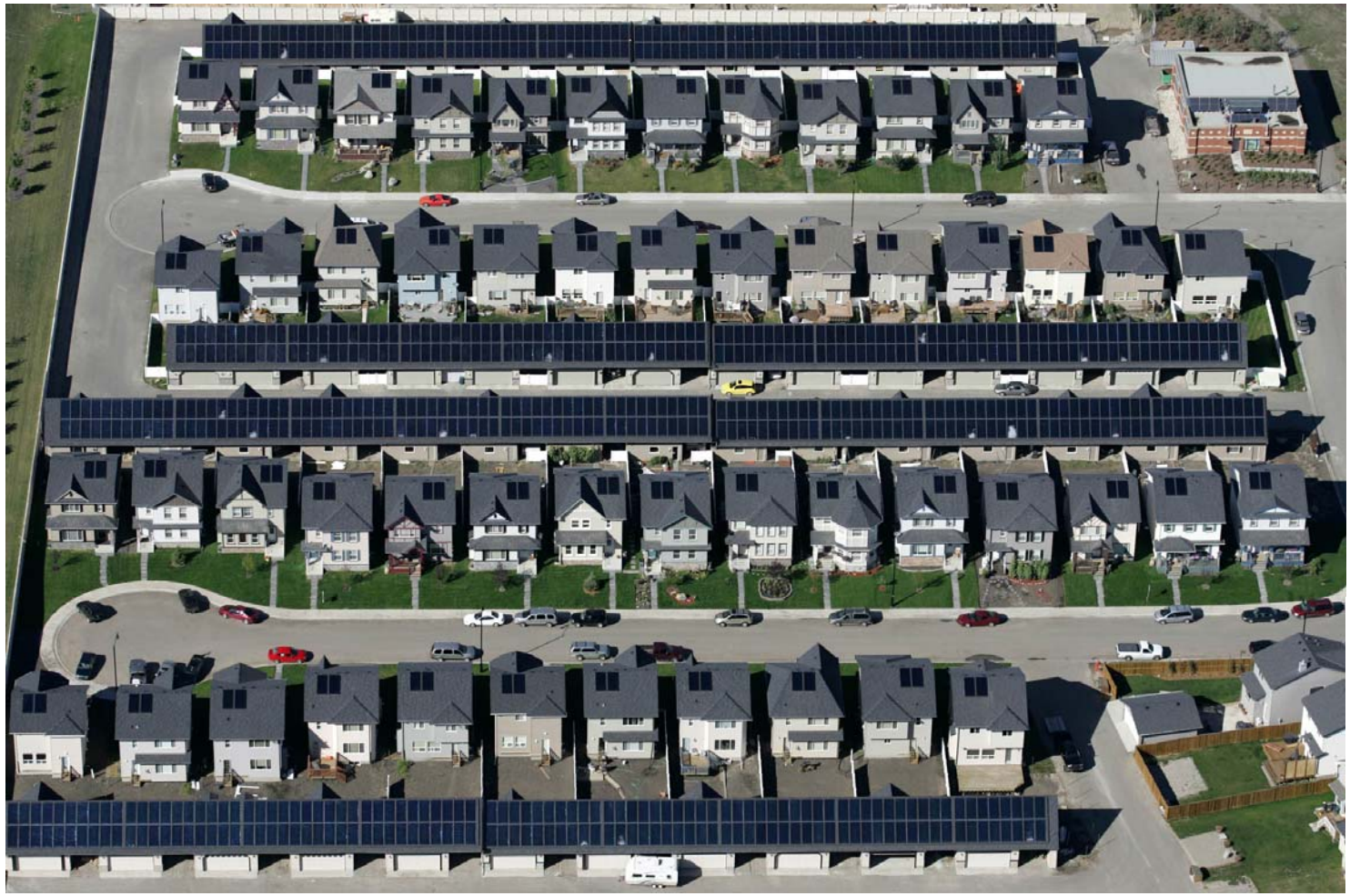
Okotoks
Historic Past, Sustainable Future

DRAKE LANDING SOLAR COMMUNITY



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FLETCHER BUISNESS PARK, ASHVILLE, NC
SOLAR HEATING AND COOLING – 1.M SQ FT

- 640 collectors, two groups of 320, 10 collectors each array

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Questions?