

# Green Building Workshop Series Eco-City Alexandria Initiative



## Workshop 5: Renewable Energy Systems and Green Power

September 24, 2011

9:00 am – 12:30 pm

Polk Elementary School

Alexandria, Virginia

# Workshop Overview

1. Photovoltaic Systems for Homes
3. Solar Hot Water Systems
4. Alexandria Homeowner Perspective
5. Geothermal Systems
6. Green Power Purchases
7. Tour of Polk Elementary School

# Green Building Workshop Series

*Next Workshop, Save the Date NOW!*

Green Operations for Retail, Restaurants, and Small Offices – **October 26, 2011**

*Workshop series funded by EECEBG.*

# Eco-City Alexandria

## Eco-City Charter Principles

- Land Use and Open Space
  - Water Resources
    - Air Quality
  - Transportation
    - Energy
  - Building Green
    - Solid Waste
  - Environmental Health
- Emerging Threats & Climate Change
  - Implementation
- **Environmental Action Plan**

# Real Energy Efficiency and Free Clean Energy for Virginia and America in a New Era

Stan Lassiter, General Manager,  
Continuum Energy Solutions

September 24  
2011

# The truth about a professional energy audit:



## A Professional Energy Audit Includes:

- Listen to owner's concerns, needs, goals & plans
- Detailed inspection of the home's shell and insulation

## Audits may include the following tests:

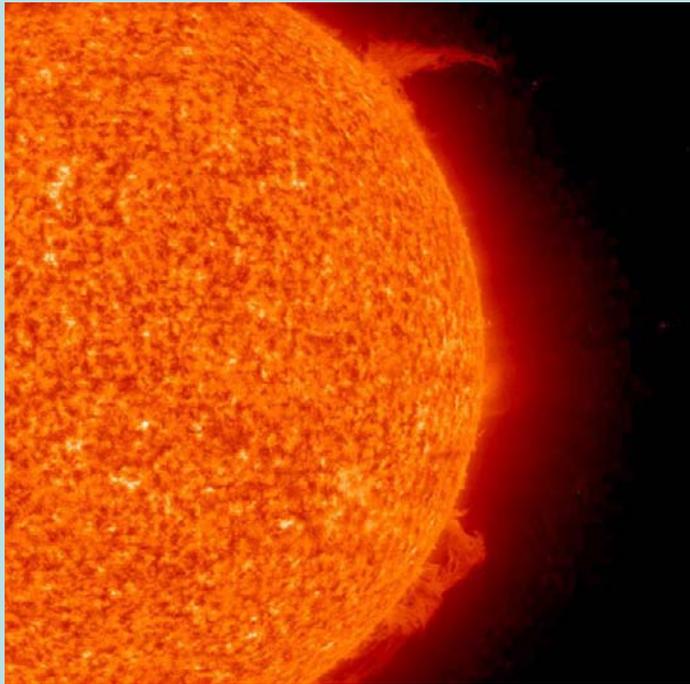
- Combustion Safety Test (Furnace and Hot water heater test)
- Back draft, CO, gas leakage and flame roll-out test
- Blower Door Test (Air Infiltration Test)
- Thermal Imaging (Insulation Test)
- Lighting inspection
- Water flow rate/fixture Inspection
- Solar Site Analysis
- Report with custom recommendations
- Test out after work is completed



# Energy Audit Economics

- Energy Audits start at \$400. The state of VA offers rebates now for energy audits and efficiency work. Up to \$250 for energy audits and \$345 toward retrofit work. Up to \$595 – total – can all go to retrofit work if an energy audit has recently been done.
- The recommended remediation work averages about \$2000 and saves on utility bills.
- Payback averages 2-4 years – then savings continue – with an average ROI of 25-50%.
- Energy savings is usually 20-30% on ALL your utilities.

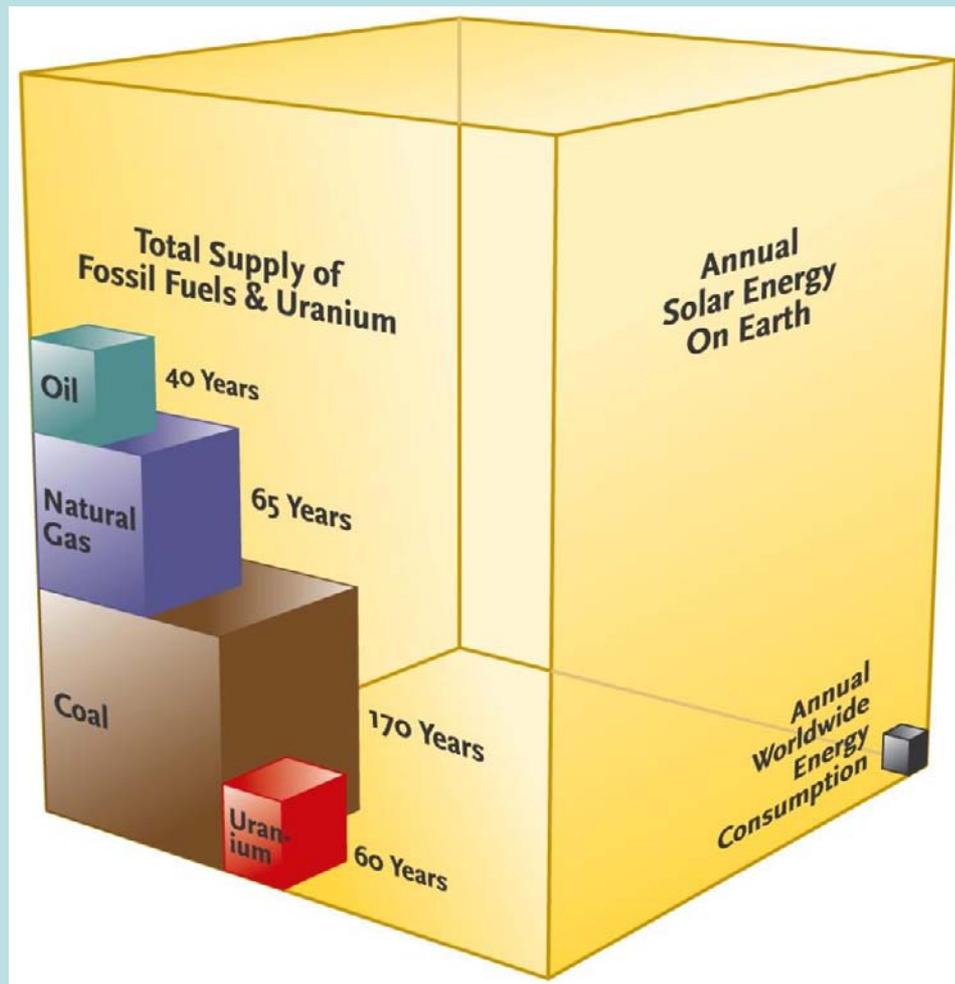
# Solar Energy



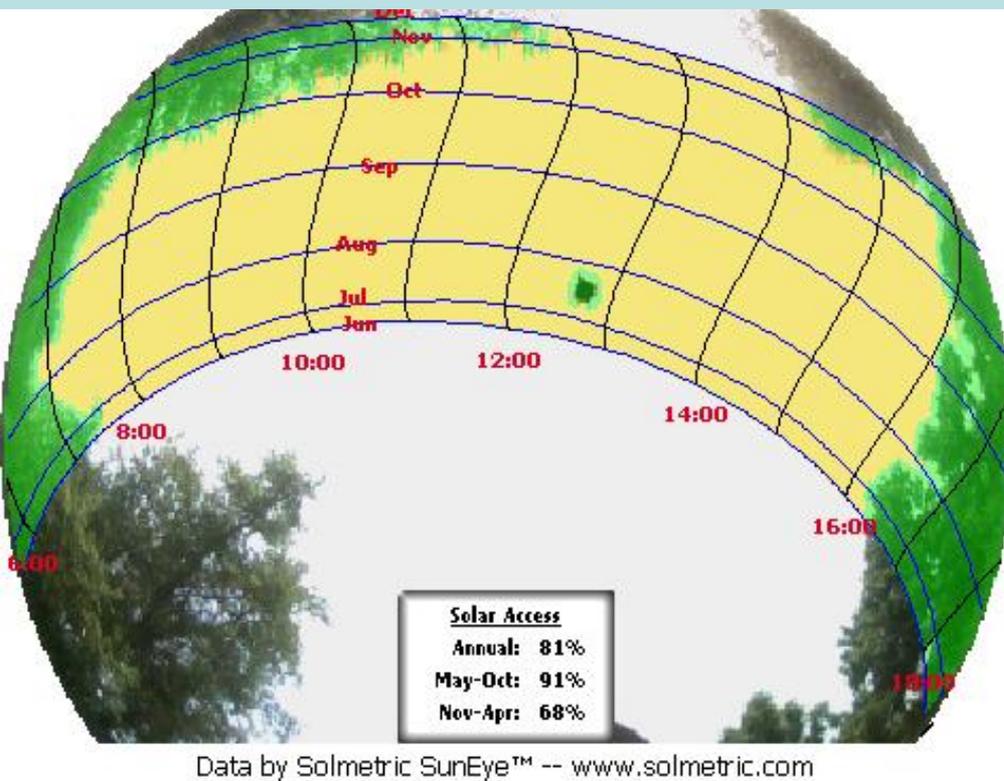
- Solar energy is the solar radiation emitted from our sun comprised of heat & light
- A very sustainable energy resource
- 1 sq ft of surface in the U.S. gets 570,000 BTUs of energy each year
- Focusing a 6" x 9" area of sunlight to pencil size will heat it to 451° F
- In one minute enough solar energy reaches the earth to meet the world's energy needs for one year!

# Solar Potential

- Annual solar energy available dwarfs total known fossil fuel reserves.
- The solar resource is tremendous in all 50 states



# Solar Site Analysis



- New Technology analyzes the exact solar resource at one or more locations.
- Trees can be digitally “erased” to determine solar gains from pruning trees.
- 70% minimum required for most incentive problems
- Accommodations for seasonal leaf variation and tree growth offer a more exact estimation of solar resource
- More sun needed for Solar Photovoltaics (PV) than for Solar Thermal

# TWO types of *Active* Solar Energy Systems

## 1. **Solar Thermal/Solar Hot Water**

The radiant heat from the sun is captured in a collector to heat water or a non-freezing glycol mix (food additive) as it is pumped across a dark heat absorbing plate.

## 2. **Photovoltaic (PV) - Electricity generating**

Uses the light from the sun to release electrons in a silicone or other photovoltaic cell which are then collected to produce DC power.

# Solar Hot Water Systems



- Transfers the sun's *heat* energy from roof collectors to heat about 80% of your **domestic hot water**
- 15-25% of a home's energy use goes to heating the domestic hot water -2nd largest load after heating and air conditioning
- The most economical solar system choice with a low price & faster ROI
- Additional storage possible – current tank often used
- Best for **radiant floor heating and pools**
- Super efficient with **on demand hot water systems**
- Lasts decades
- Made with recycled materials

# Solar Photovoltaics (PV)

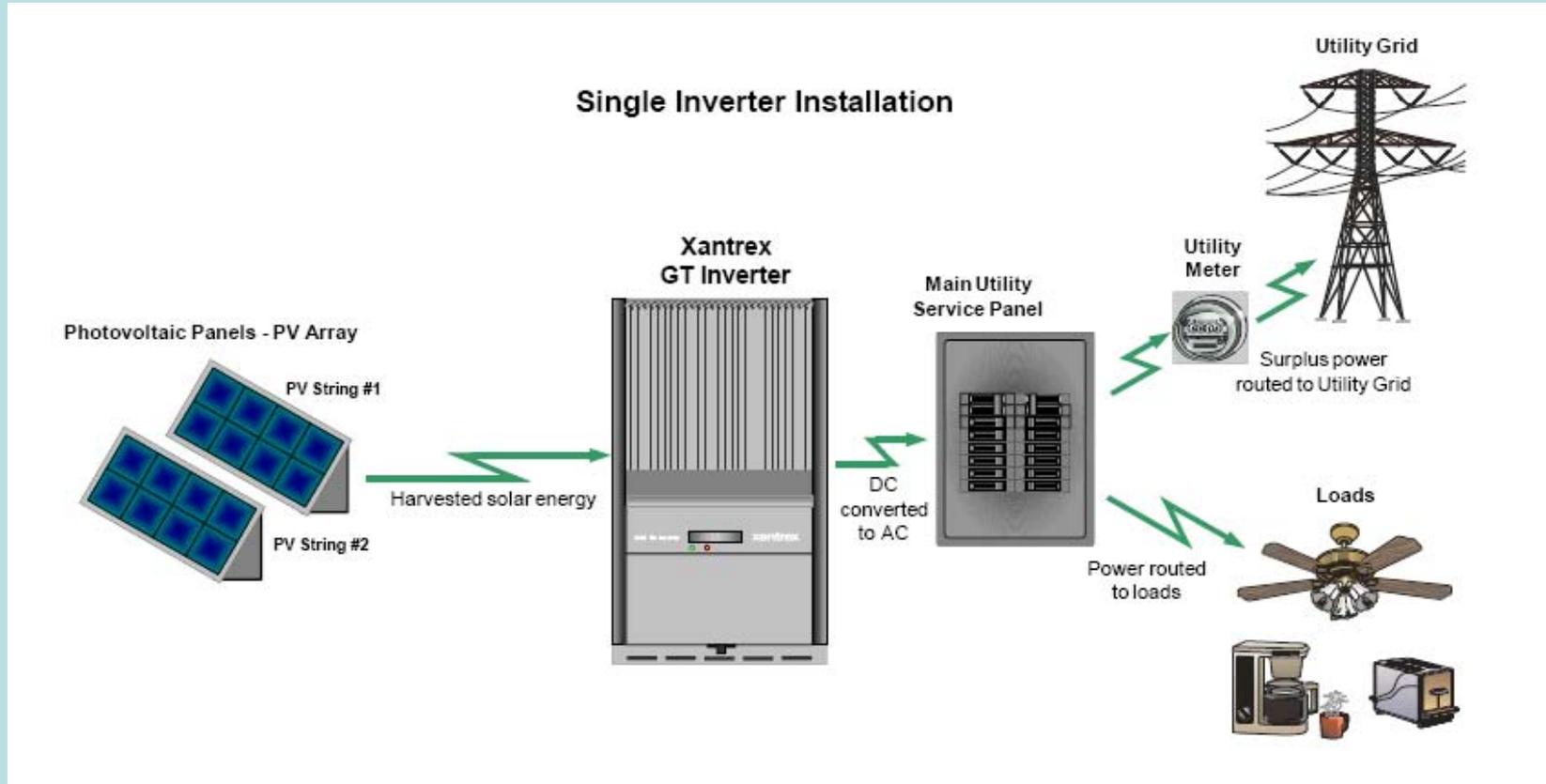
- Produces Electricity from sun light
- 100% Renewable and Sustainable
- Clean – No pollution - Silent
- Recycled
- No moving parts
- Zero carbon emissions!\*
- Energy price never goes up, always FREE
- Become your own power plant
- Systems last 40-50 years
- **Distributed power** – 1kwh = 1kwh, not 3.3kwh = 1kwh like with the current technology



# Photovoltaic Panels – Polycrystalline



# Grid-tied PV System



# Photovoltaic Panels and Solar Thermal



## New Technology! - Enphase Microinverters



- One inverter behind each panel- many benefits!
- Cheaper to install with no central inverter location needed
- Reduces the effects of shading
- Cheaper to expand systems
- Excellent individual panel data monitoring
- Enables quicker repair and troubleshooting

# Enphase Data Monitoring



# Net Metering

- Laws exist in 40 states mandating that utilities give you credits on your bill for nearly (but not more than) 100% of your bill!
- Virginia's net metering policies increased in 2011 from 10 to 20kw maximum residential system size. The SCC will decide soon about additional stand-by charges for 10-20kw systems.
- Your electric meter tracks your net usage, spinning forward when using power or backwards when generating a surplus of power. Your neighbor gets your clean energy when you are not using it!
- The utility grid acts like a 100% efficient battery bank.

# Solar - A Unique Investment

- Solar is the only financial investment where the return is guaranteed. These systems produce power and are monitored easily online. System life expectancy is 40-50 years. Manufacturers offer 25 year product warranties.
- The Appraisal Journal has reported that a home's market value goes up \$20 for every \$1 in annual energy costs saved – so the average \$400 yearly savings a solar hot water system offers adds \$8,000 to the value of your home the day it is installed!
- Solar is different from fossil fuels as the more we use it the cheaper it gets.
- Solar has tremendous potential to reduce demand for dirty energy in Virginia.

# System Life Cycles

- Hot water systems last 30-40 years and will need only the pumps replaced after about 15 years.
- PV systems last 40-50 years and need the inverter replaced after about 15 years.
- Roofs which are more than 7 years old should be replaced prior to a PV system being installed
- Metal roofs are recommended because they are cooler and longer lasting. This increases the efficiency and helps maximize the potential operating life of the system.

# PV Experience Curve

- Global output was 5MW in 1979 and 2,000MW in 2006. Wholesale price of PV dropped from \$32/watt to \$3.50/watt. It dropped 50% each decade.
- Now at \$2.50/watt! **30% drop in the last 12 months**
- Experts see a continued classic experience curve with prices predicted to fall 18% for every doubling of worldwide production volume.
- Electronics giants like Sharp, Sanyo and Sunpower will lead the way.
- Grid parity for PV compared to coal fired electric is predicted in 2-10 years

# Solar Economics are great in Virginia, NOW!

- **Photovoltaic prices are down 30% in the last 12 months!**
- **The government pays for up to 40% of the cost of systems!**
- **Hot Water systems start at \$8,750. Include the 30% Tax Credit/Grant and the price drops to \$6,125.**
- **Photovoltaic systems (2.53KW) start at \$19,860. Include the 30% Tax Credit/Grant and the price drops to \$13,902. Also about \$150 in annual projected payments for RECS – Renewable Energy Credits**
- **The City of Alexandria offers annual credits of 1/100 system costs times current tax rate (.998) Nearly \$200 for every \$20,000 in system cost.**

# Array Orientation & Attachment

- Roofs facing SE to SW are ideal for solar
- Low pitch East/West roofs can be used for solar thermal
- Flat roofs can accommodate a racking system which is held in place by ballast. No penetrations needed!
- Ground mounts are an excellent alternative for those with roof shading or aesthetic concerns



## Racking Options

- Roof mounted



## Racking Options

- Ground mounted

## Array Size

**Q. How much space is needed for hot water panels?**

A. 1 or 2 – 4'x8' panels are used for a typical single family home.

**Q. How much space is needed for a PV array?**

A. 100 square ft per kW.

## Top 6 Solar Benefits

- Protection from the effect of utility rate hikes – when you own the system your electricity will **always** be **FREE!**
- Value - Solar **increases the value of your home without increasing the assessed property taxes or insurance**
- Increases our Local & National **Security**, Economic **Security** & Energy **Security**
- Every dollar spent on solar will ultimately lower the price in the future - **the opposite of the current fossil fuel sources**
- **Creates local sustainable jobs** & keeps \$\$ in the local economy instead of increasing our trade deficit
- Smart meters & dynamic pricing for electricity will be fully in place in VA in 3 years. Solar PV **produces maximum power during peak power periods** for the utility, eliminating the need to add new, expensive power lines and dirty power plants **AND** avoiding brownouts and blackouts

## The Department of Energy says

- By 2025 half of new U.S. electricity could come from the sun
- By 2030 the U.S. is estimated to generate 200 GW of solar power

# Government & Utility Company Leadership

- NJ Public Service Electric and Gas has proposed to invest in, own, and operate 120MW of PV at distributed school and government facilities, low income housing sites and other rooftops.
- Duke Energy of NC plans to put 20 MW of PV over hundreds of distributed rooftops.
- PA Solar capacity set to triple with 23 million in grants & loans.
- VT just passed a Feed in tariff (FIT) law which will pay producers of clean energy for each kWh produced for 25 years

## Challenges in Virginia

- Virginia General Assembly has passed legislation which would allow stand-by charges for PV systems sized 10-20kw. These charges could set a precedent for having charges on all other systems and could be expensive. The charges will lengthen ROI and discourage solar investment in Virginia.
- Permitting: In Alexandria and most of Virginia it is expensive and difficult. It is usually over \$1000 and must be included in the installed price. The process usually takes a long time as few folks have experience with these systems, and the experience can be described as “brutal”.

# Trade Opportunities / Green Jobs

- Sales/Design of Solar Energy Systems
  - Installers/Repair/Maintenance of Solar Energy Systems
  - Energy Auditors
  - Insulation/Remediation Technicians
  - Project Managers
  - Entrepreneurs
  - Instructors
  - Solar Aggregators
  - Electric Station Installers
1. Sustainable
  2. Growing Industry...69% last year
  3. Valuable Plumbing and Electrical Trade Skills are Learned
  4. IT Skills are Learned
  5. **Price of panels continues to drop – 30% drop this year**

# Energy Efficiency & Clean Energy = Jobs!

**“Renewable energy and energy efficiency currently provide more than 9 million jobs and \$1,045 billion in revenue in the U.S. (2007).”**

**“37 million jobs from renewable energy and energy efficiency are possible in the U.S. by 2030...”**

**- American Solar Energy Society**

## Spread the word – Solar is unique!

- Solar Energy is FREE!
- The Solar resource in Virginia is tremendous!
- Solar Creates Jobs, Income for System Owners, and Increases our National Security
- Solar is Good for Our Community & America!

Thank You

Stan Lassiter, General Manager

Continuum Energy

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703-354-0262

# Solar Hot Water and Thermal Applications

**Presented By  
Richard Good, President, and  
Nathan Farley, Sales Consultant  
Solar Services, Inc.**

**September 24, 2011**

## Quotes

*I'd put my money on  
the sun and solar  
energy. What a source  
of power!*

*I hope we don't have to  
wait until oil and coal  
run out before we tackle  
that.*

*We do not inherit  
the earth from our  
ancestors;  
We borrow it from  
our children.*

*1931*

*Thomas Alva Edison*

*Chief Seattle*

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DSIRE is a comprehensive source of information on state, local, utility and federal incentives and policies that promote renewable energy and energy efficiency. Established in 1995 and funded by the U.S. Department of Energy, DSIRE is an ongoing project of the N.C. Solar Center and the Interstate Renewable Energy Council.

Choose one or both databases:  
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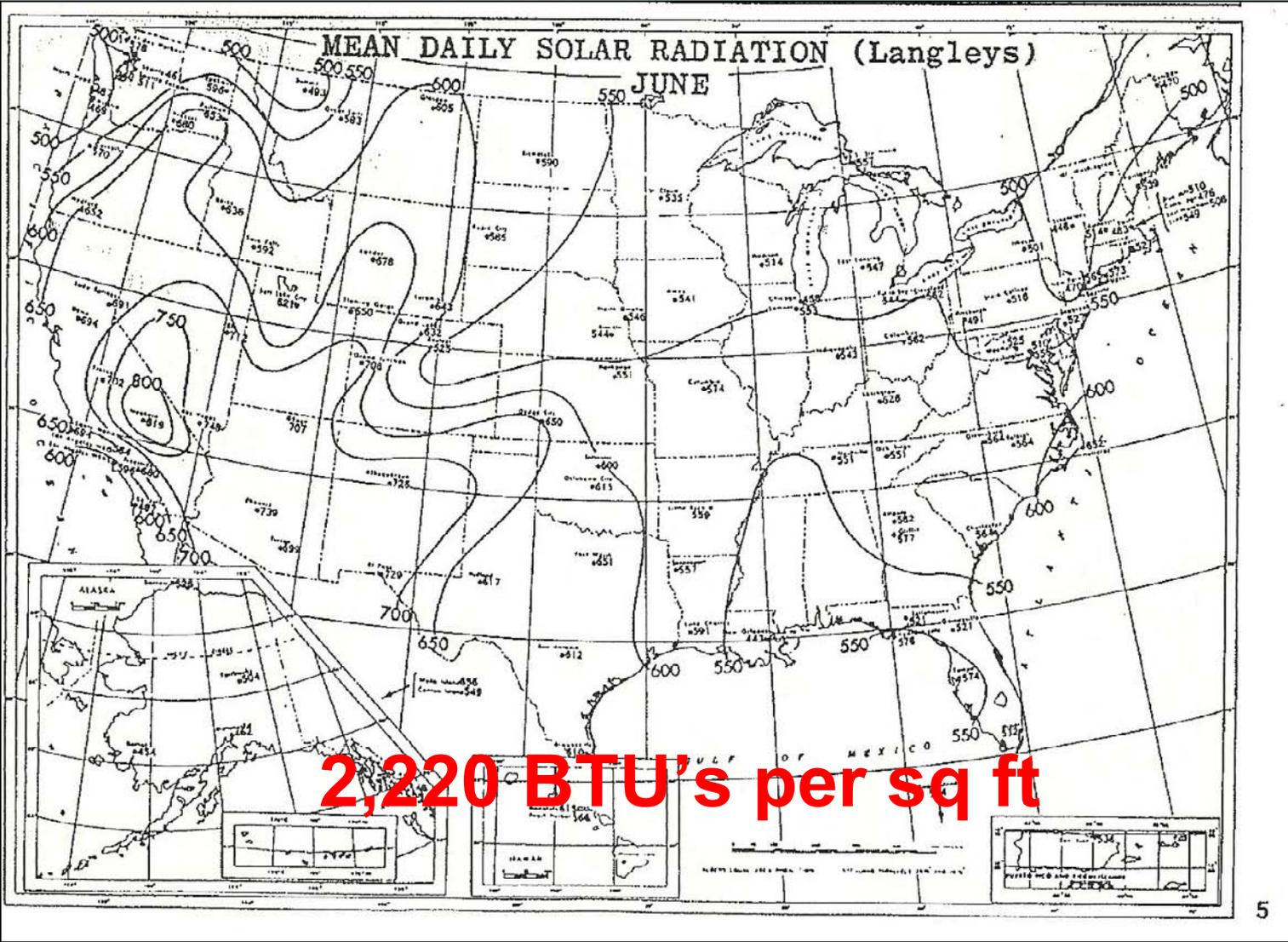


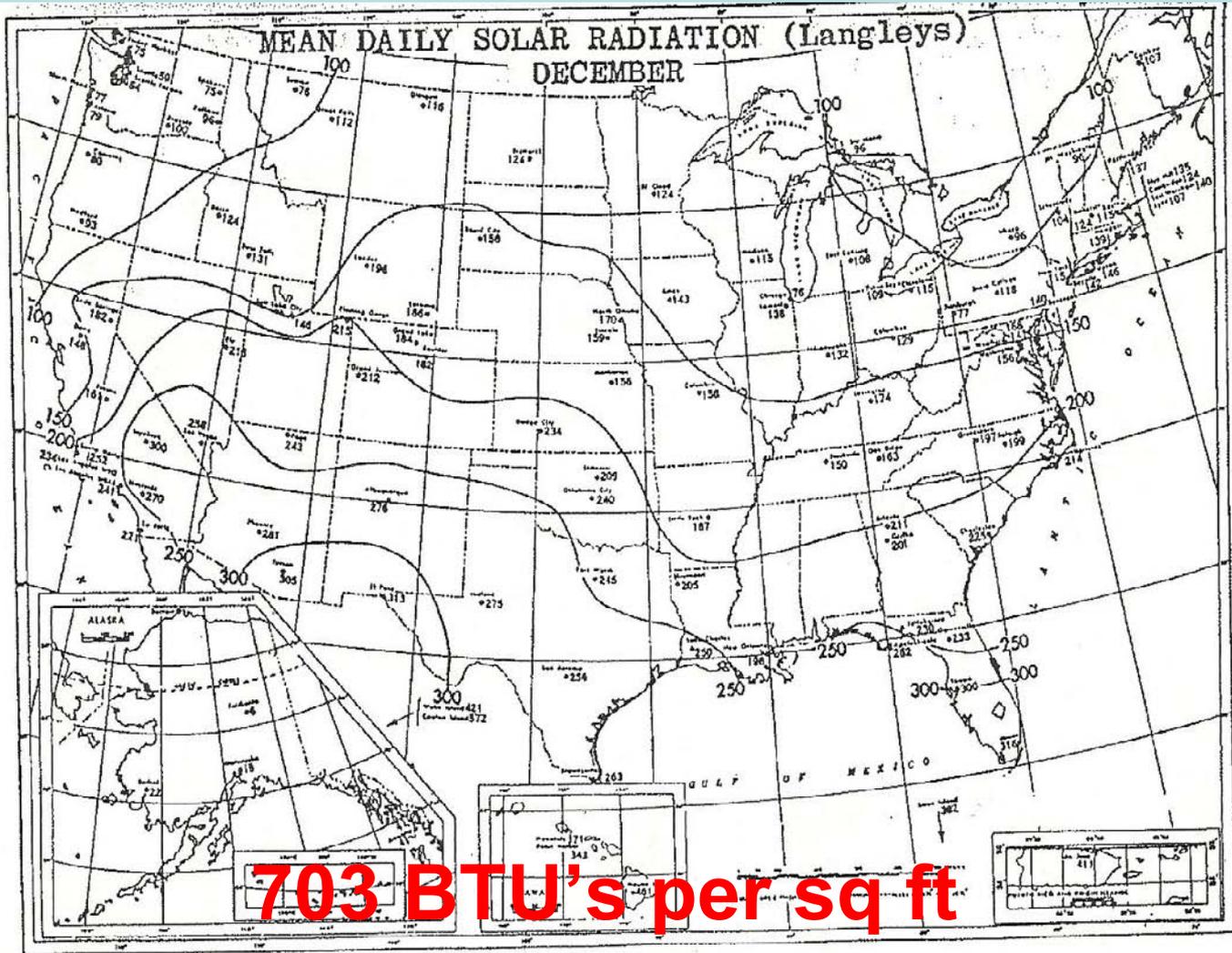
NC STATE UNIVERSITY

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While the DSIRE staff strives to provide the best information possible, the DSIRE staff, the N.C. Solar Center, N.C. State University and the Interstate Renewable Energy Council make no representations or warranties, either express or implied, concerning the accuracy, completeness, reliability or suitability of the information. The DSIRE staff, the N.C. Solar Center, N.C. State University and the Interstate Renewable Energy Council disclaim all liability of any kind arising out of your use or misuse of the information contained or referenced on DSIRE Web pages.

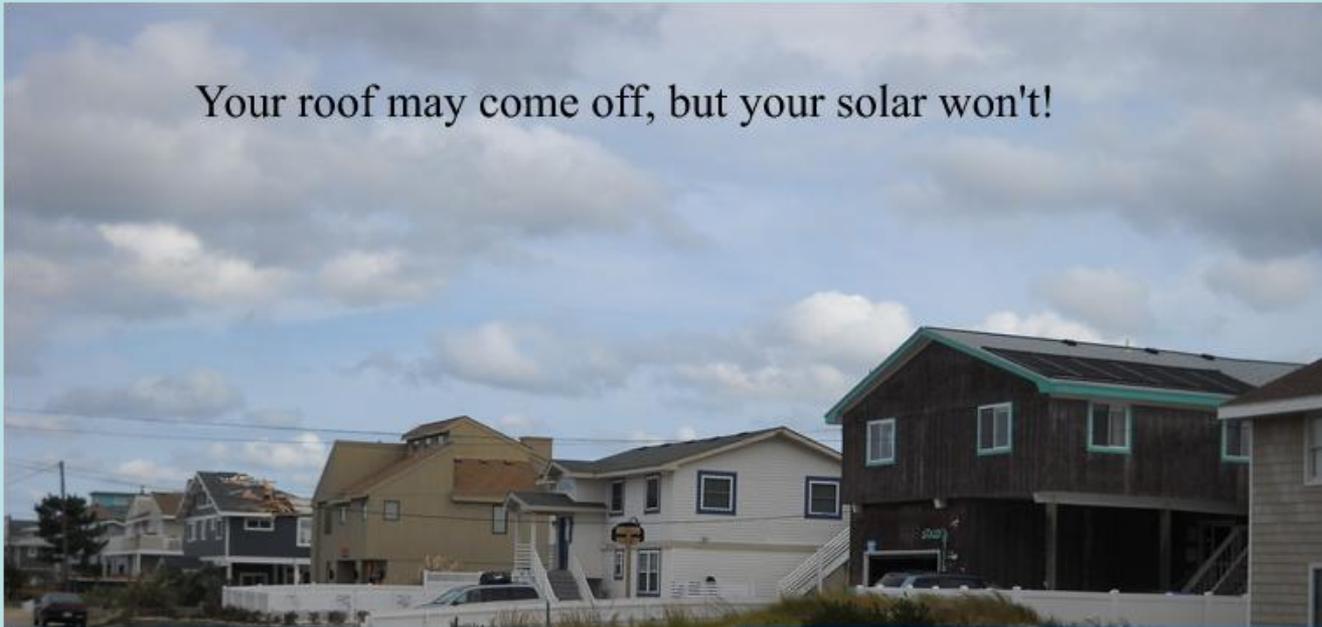
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# Worried about your collectors blowing off the roof?

Your roof may come off, but your solar won't!



## Installed To Last

Our systems are installed to withstand  
the severest weather conditions



Wednesday evening's tornado did about \$40,000 damage to Robert Boyd's home at 8215 S.W. 13th Ave.

# Residential Solar Heating Collectors

Solar Collectors heat fluid or air. This is then used to heat directly or indirectly the following:

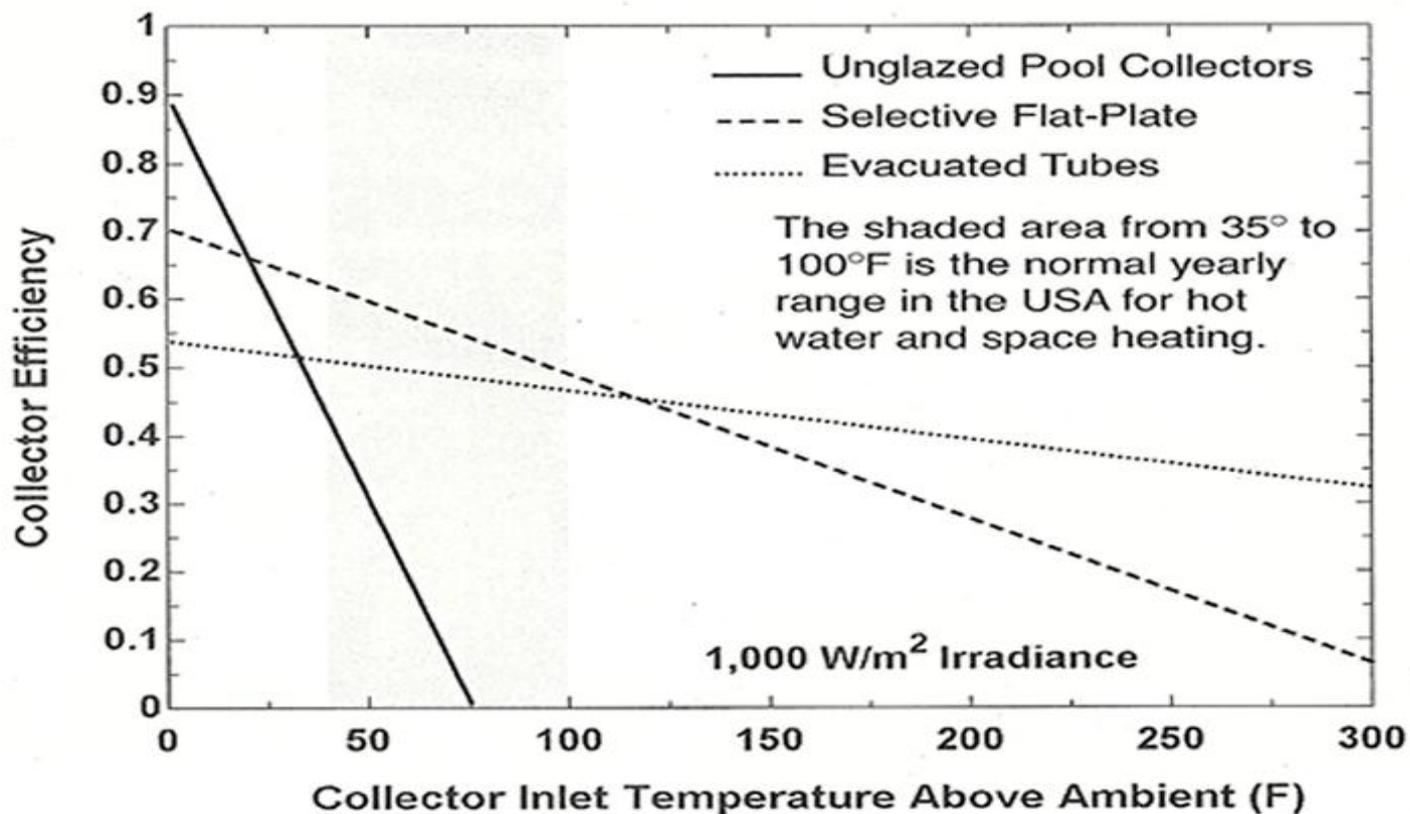
- Water for household use
- Indoor Spaces
- Water for swimming pools
- Water or air for commercial use

# Low Temperature Applications

Pool Heating

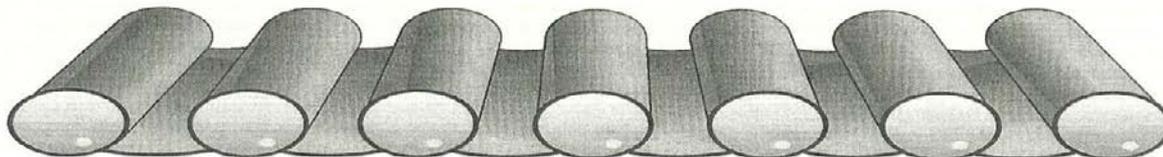
Thermal Systems- space heating

# Unglazed Pool Collectors



# Tube & Web

Manufacturers: Aquatherm's Solar Industries model and Hi-Tec



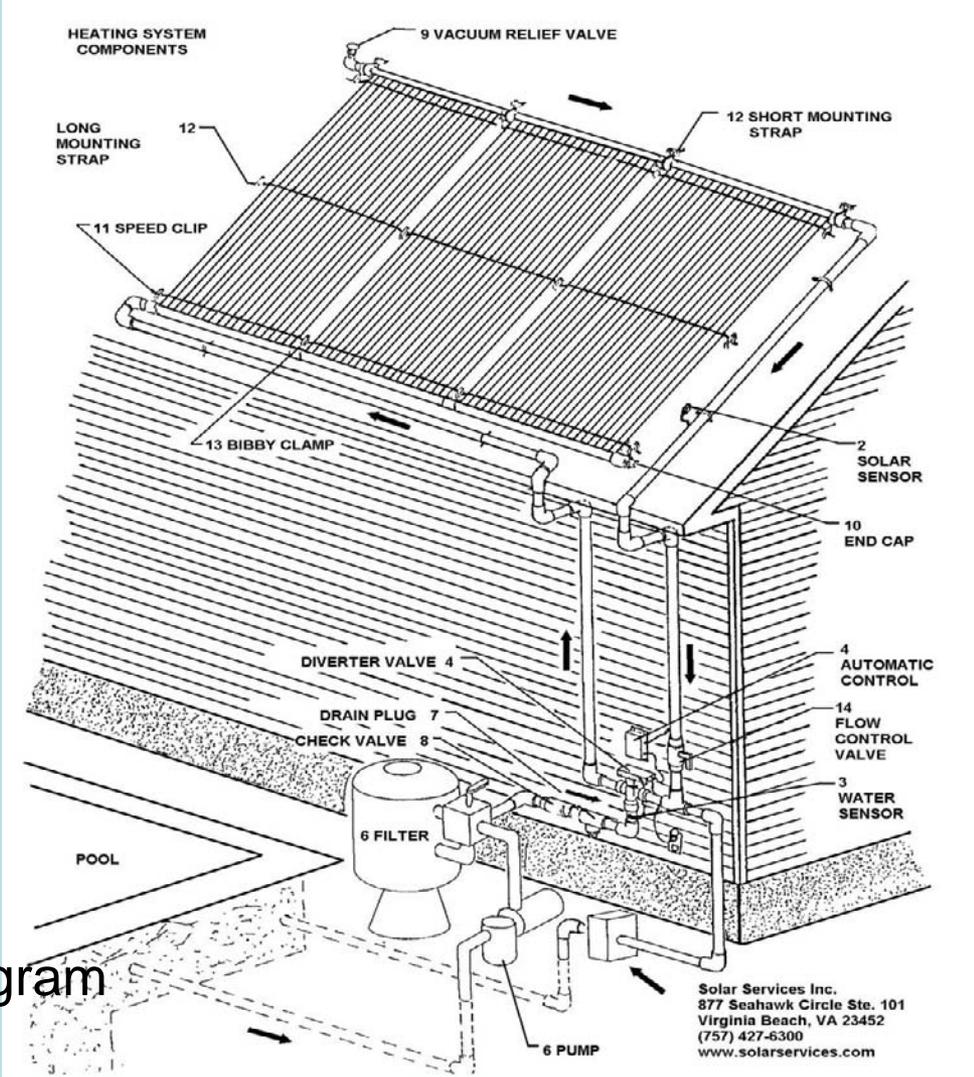
This design is extruded in 6" wide sections with intermittent bonds between each section to allow for expansion and contraction. This use of a web rather than direct connections between the tubes reduces stress on the tubes and allows a direct feed header system to be used. This is the best design for asphalt shingle roofs - no substrates are required.

**Excellent for heating pools under a wide range of weather conditions.**

- **This collector design can be easily repaired at the header.**
- **This design allows the collector to adjust and lie flat as stresses from expansion and contraction are released. Stainless steel straps and mounting hardware can be used.**
- **The only design that does not move back and forth on the roof. Expands a little vertically at the bottom header.**
- **The size, shape, and spacing of the tubes contribute to the high thermal efficiency of this collector.**
- **Direct feed headers improve flow rates and relieve back pressure on the pool equipment. Aquatherm's Solar Industries models have risers with metered flow into the headers.**
- **This is a proven design that has been in continuous operation for more than 20 years.**
- **The stainless steel straps used by Aquatherm's Solar Industries model and header clamps are excellent mounting hardware for hurricane areas.**

# Solar Pool Heating





Solar Pool Heating Diagram

# Solar Pool Heating System



# Solar Pool Heating Service



## Warm Air Thermal Collector



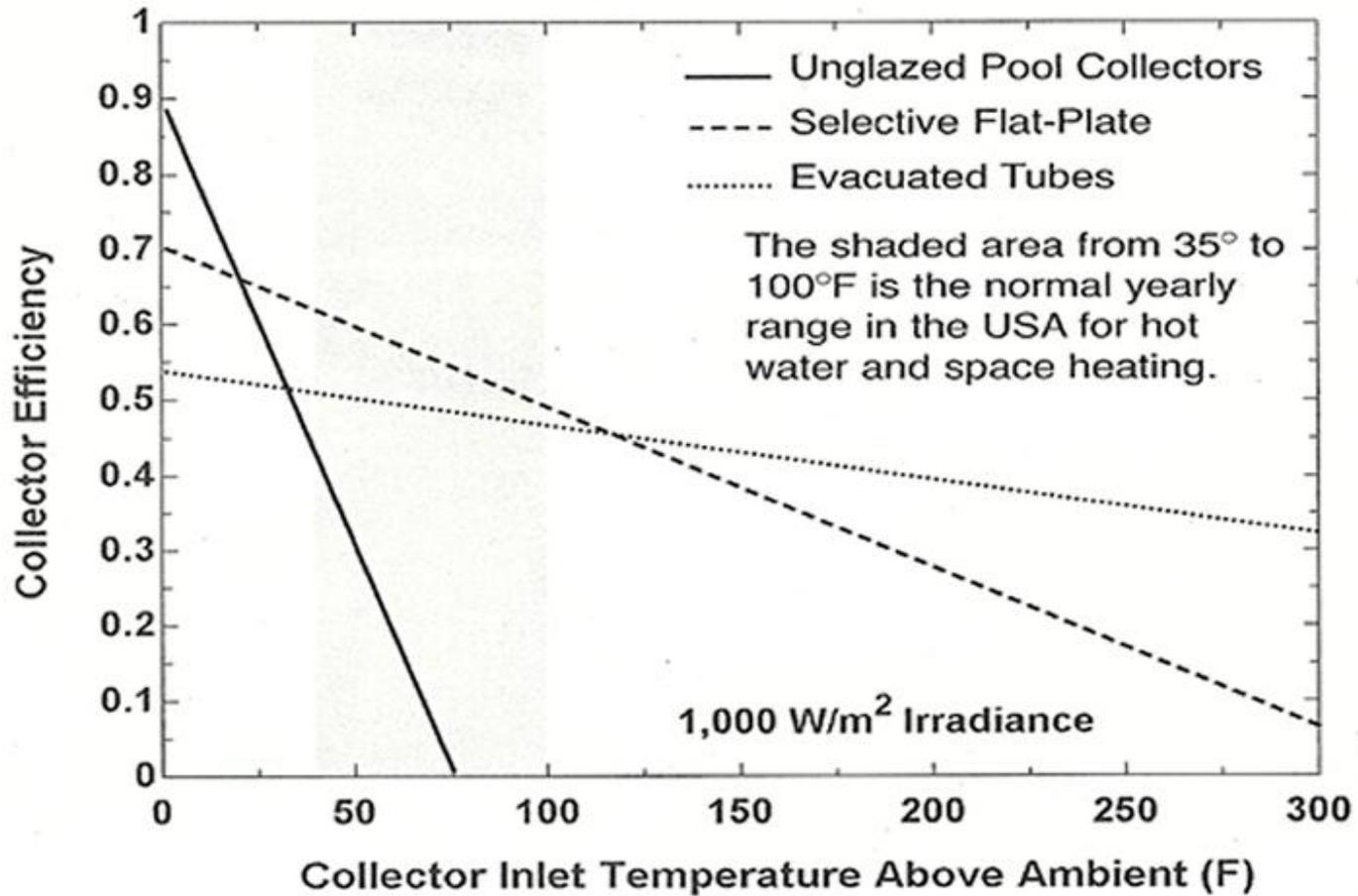
# Radiant Floor Heat

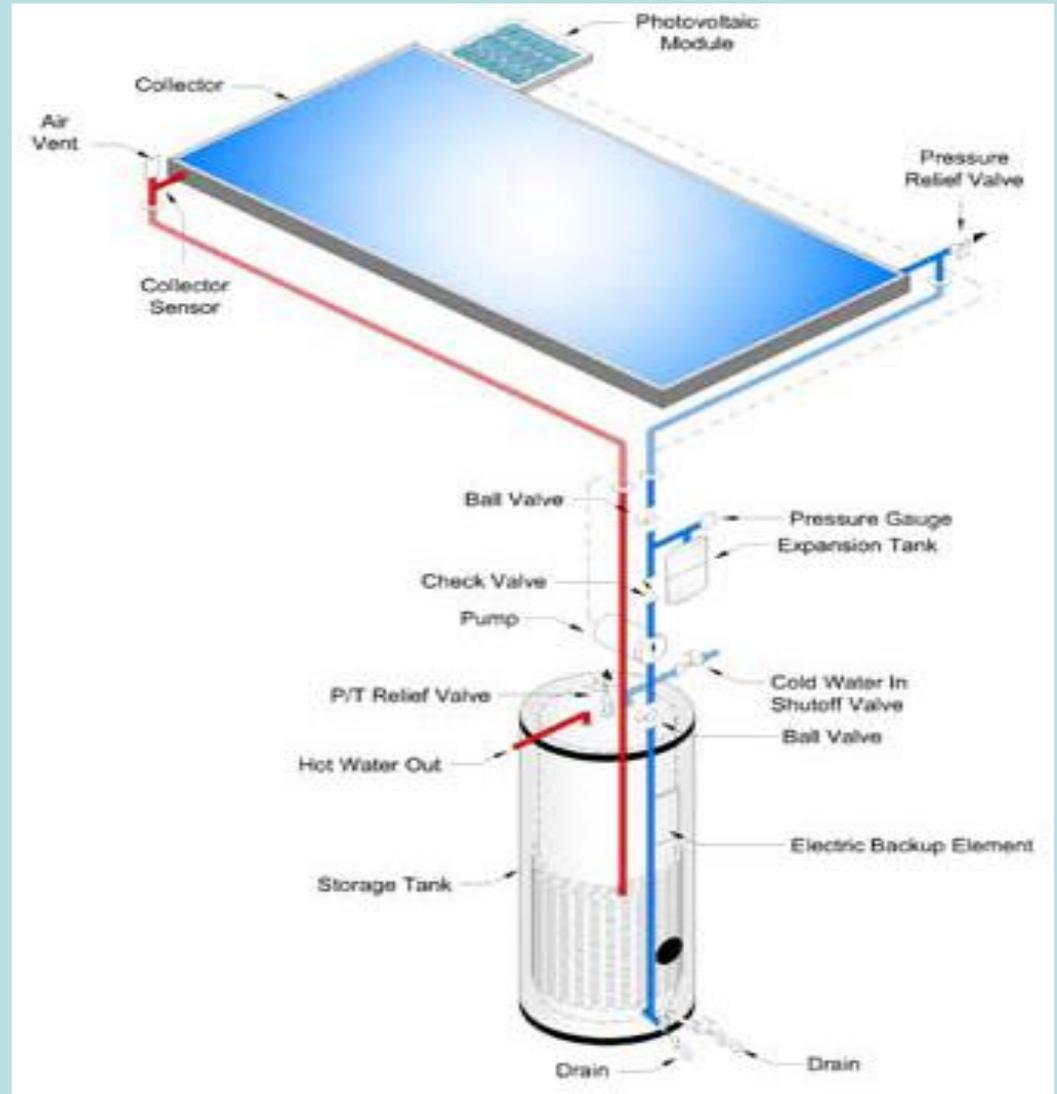


# Medium/High Temperature Applications

**Solar hot water:**

**Flat plate or Evacuated tubes**





# Solar Hot Water Diagram

# Collectors



## AE-Series Collectors with exclusive - selective "Crystal Clear" inside

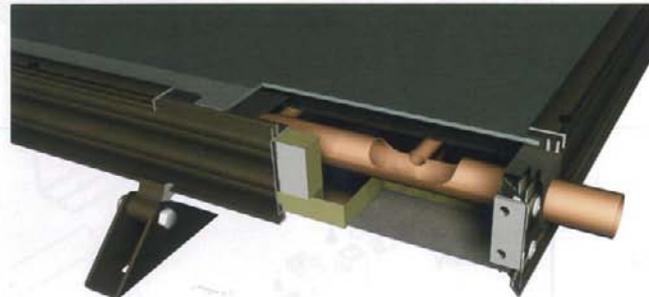
**Glazing:**  
Low-Iron tempered glass, exclusively using our "High-T" tempered glass, with a total solar energy transmission of 90%.

**Collector Frame and Battens:**  
Type 6063-T6 extruded aluminum frame and battens with electrostatic bronze plate finish that facilitates long life and strength.

**Insulation:**  
Polyisocyanurate foam board insulation. Foil-faced, glass fiber-reinforced, rigid board Thermax sheathing (1-1/4" in the bed / 3/4" in the sidewalls).

**Mounting Hardware:**  
The variable "Quick Lock" mounting hardware reduces mounting time and makes it simple for anyone to install. The Quick Lock System allows the highest flexibility in mounting and is tested to wind load conditions of 195 mph. Mounting possibilities include: Pitched roof, Flat roof, Ground, Balcony, and Facade mounting.

**Design Life:** 30 Years  
**Warranty:** 10 Years  
**Working Pressure:** 165 PSI  
**Flow Rate:** 0.5 to 1.8 GPM (recommended)



**Absorber Plate:**  
Manufactured by Thermafin™ Mfg., a 100% copper absorber plate, the fin and the riser tube are molecularly bonded by high-frequency forge welding.

**Absorber Coating:**  
Exclusively by Thermafin™ Mfg., a Selective "Crystal Clear" Coating.  
 $\alpha = 0.96$   $\epsilon = 0.08$

**Gasket Grommets:**  
A UV durable EPDM, U-channel gasket with molded corners which prohibits water penetration and assures long life. Extruded Silicone Grommet with 1-1/8" Bore.

**Corner Bracket:**  
Architectural aluminum angles inside with aircraft-grade pin grip rivets to ensure high stability.

**Fasteners:**  
5056 Aluminum rivets secure the backsheet. Batten screws are 18-8 SS, 10-24 x 3/8", hex head screws, and black oxide coated.

**Backsheet:**  
Type 3105-H14, 0.019" stucco embossed aluminum sheet (bronze) pop-riveted to aluminum frame.

	SPECIFICATIONS					
Collector	AE-21	AE-24	AE-26	AE-28	AE-32	AE-40
Length (in)	85.187	97.187	77.187	85.187	97.187	121.187
Width (in)	35.187	35.187	47.187	47.187	47.187	47.187
Height (in)	3.137	3.137	3.137	3.137	3.137	3.137
Gross Area (ft <sup>2</sup> )	20.8	23.7	25.3	27.9	31.8	39.7
Transparent Area (ft <sup>2</sup> )	19.2	21.9	23.6	26.1	29.9	37.4
Dry Weight (lb)	74	84	90	99	113	153

Solar Services Inc.  
877 Seahawk Circle Ste. 101  
Virginia Beach, VA 23452  
www.solarservices.com  
(757)427-6300

<b>SOLAR COLLECTOR CERTIFICATION AND RATING</b>  SRCC OG-100	<b>CERTIFIED SOLAR COLLECTOR</b>  SUPPLIER: Alternate Energy Technologies 851 Energy Cove Court Green Cove Springs, FL 32043 USA MODEL: Alternate Energy AE-32 COLLECTOR TYPE: Glazed Flat-Plate CERTIFICATION#: 2002001E
---	--

Kilowatt-hours Per Panel Per Day				Thousands of BTU Per Panel Per Day			
CATEGORY (Ti-Ta)	CLEAR DAY	MILDLY CLOUDY	CLOUDY DAY	CATEGORY (Ti-Ta)	CLEAR DAY	MILDLY CLOUDY	CLOUDY DAY
A (5 °C)	12.2	9.2	6.3	A (49 °F)	41.7	31.5	21.3
B (5 °C)	11.1	8.1	5.1	B (36 °F)	37.9	27.7	17.5
C (20 °C)	9.3	6.4	3.6	C (36 °F)	31.7	21.8	11.9
D (60 °C)	5.6	3.0	0.7	D (90 °F)	19.0	10.1	2.2
E (80 °C)	2.2	0.3	0.0	E (144 °F)	7.4	1.1	0.0

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: 22-NOV-02

**COLLECTOR SPECIFICATIONS**

Gross Area: 2.965 m<sup>2</sup> 31.91 ft<sup>2</sup>  
 Dry Weight: 51.2 kg 113. lb  
 Test Pressure: 1103. KPa 160. psig

Net Aperture Area: 2.78 m<sup>2</sup> 29.93 ft<sup>2</sup>  
 Fluid Capacity: 4.9 liter 1.3 gal

**COLLECTOR MATERIALS**

Frame: Anodized Aluminum  
 Cover (Outer): Low Iron Tempered Glass  
 Cover (Inner): None

**Pressure Drop**

Flow		ΔP	
m/s	gpm	Pa	in H <sub>2</sub> O

Absorber Material: Tube - Copper / Plate - Copper Fin  
 Absorber Coating: Selective Coating

Insulation Side: Polyisocyanurate  
 Insulation Back: Polyisocyanurate

**TECHNICAL INFORMATION**

Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta] Y INTERCEPT      SLOPE  
 SI Units:  $\eta = 0.691 - 3.39600 (P)^1 - 0.01968 (P)^2$  0.706      -4.910 Wm<sup>-2</sup>·°C  
 IP Units:  $\eta = 0.691 - 0.59821 (P)^1 - 0.00193 (P)^2$  0.706      -0.865 Btu/hr.ft<sup>2</sup>·°F

Incident Angle Modifier [(S)=1/cosθ - 1, 0° < θ < 60°]  
 K<sub>τα</sub> = 1      -0.194 (S)      -0.006 (S)<sup>2</sup>  
 K<sub>τα</sub> = 1      -0.20 (S)      Linear Fit

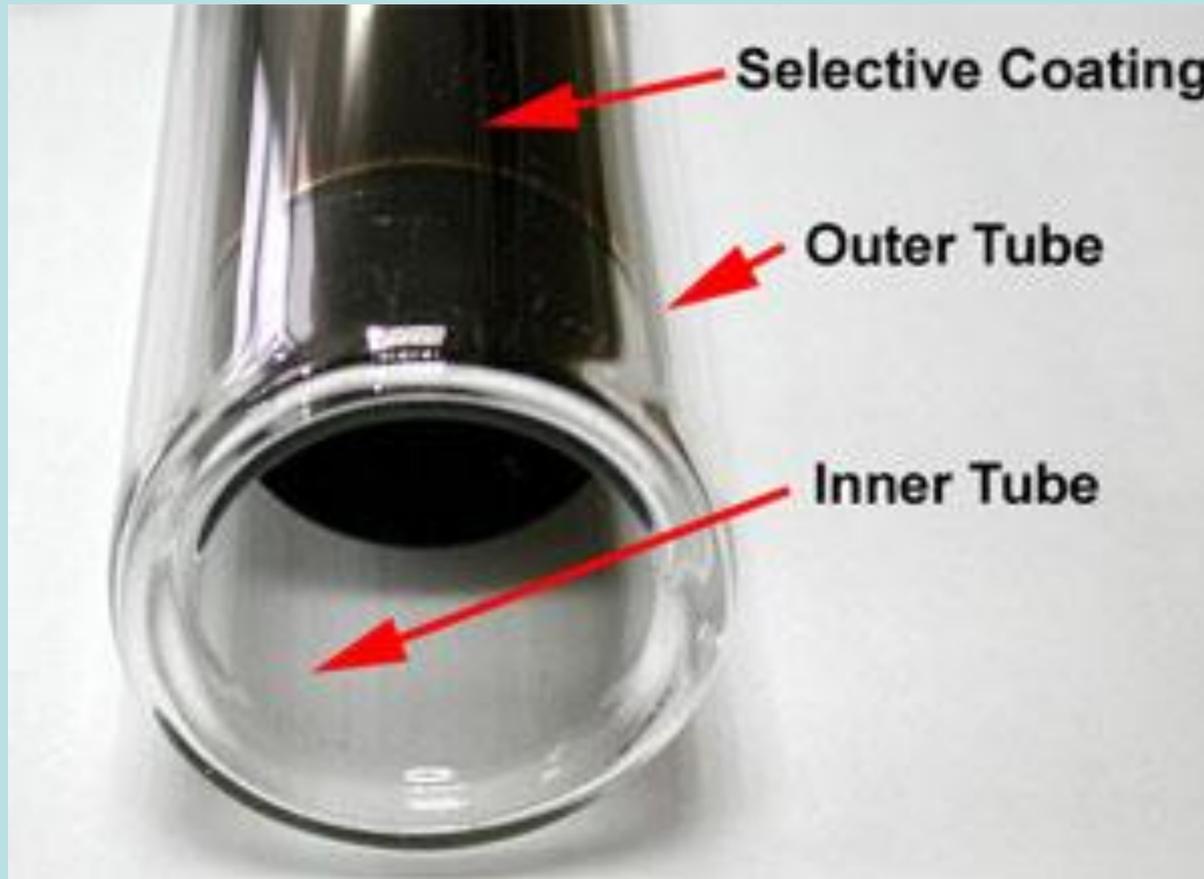
Test Fluid: Water  
 Test Flow Rate: 13.1 ml/s.m<sup>2</sup> 0.0193 gpm/ft<sup>2</sup>

**REMARKS:**

- August, 2011  
 Certification must be renewed annually. For current status contact:  
 SOLAR RATING & CERTIFICATION CORPORATION  
 400 High Point Drive, Suite 400 • Cocoa, Florida 32926 • (321) 213-6037 • Fax (321) 821-0910

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## OG Certification



## Evacuated Tubes

# Solar Hot Water Install



# Solar Hot Water Install



# Solar Hot Water Monitor



Solar Hot  
Water System  
-inside the  
house



# Solar Hot Water System -inside the house



# Solar Hot Water Tank



# Solar Hot Water



## Solar Hot Water, PV and Solar Pool Heat



# Fish Farm



# Fish Farm Tank



# BTU Generation

<b>Btu's Per Panel Per Day</b>				
<u>Category</u>	<u>Clear Day</u>		<u>Mildly Cloudy</u>	
	<i>AE-40</i>	<i>AP-30</i>	<i>AE-40</i>	<i>AP-30</i>
A) (-9F)	52	46.1	39	34.8
B) (9F)	47	44	35	32.7
C) (36F)	40	40.6	27	29.3
D) (90F)	24	34.2	13	23
E) (144F)	9	27.1	1	16.8

<b>Btu's Per ft<sup>2</sup></b>				
<u>Category</u>	<u>Clear Day</u>		<u>Mildly Cloudy</u>	
	<i>AE-40</i>	<i>AP-30</i>	<i>AE-40</i>	<i>AP-30</i>
A) (-9F)	1307	1030	980	777
B) (9F)	1181	983	880	731
C) (36F)	1006	907	679	655
D) (90F)	603	764	327	514
E) (144F)	226	605	25	375

# Evacuated Tubes





# Flat Plate



Photo by SunPower Builders

## American Made?



# What the heck is this?



<b>SOLAR COLLECTOR CERTIFICATION AND RATING</b>  SRCC OG-100	<b>CERTIFIED SOLAR COLLECTOR</b>  SUPPLIER: Dawn Solar Systems, Inc. 183 Route 125, Unit A-7 Brentwood, NH 03833 USA MODEL: Dawn Solar 3004-CT COLLECTOR TYPE: Unglazed Flat-Plate CERTIFICATION#: 2006018A
---	--

ALL SIZES OF THIS COLLECTOR MODEL ARE CERTIFIED

Kilowatt-hours Per Square Meter Per Day				Thousands of BTU Per Square Foot Per Day			
CATEGORY (Ti-Ta)	CLEAR DAY	MILDLY CLOUDY	CLOUDY DAY	CATEGORY (Ti-Ta)	CLEAR DAY	MILDLY CLOUDY	CLOUDY DAY
A (-5 °C)	0.5	0.5	0.4	A (-9 °F)	0.2	0.1	0.1
B (5 °C)	0.3	0.2	0.1	B (9 °F)	0.1	0.1	0.0
C (20 °C)	0.0	0.0	0.0	C (36 °F)	0.0	0.0	0.0
D (50 °C)	0.0	0.0	0.0	D (90 °F)	0.0	0.0	0
E (80 °C)	0.0	0.0	0.0	E (144 °F)	0.0	0.0	0.0

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: 06-NOV-06

**COLLECTOR SPECIFICATIONS**

Gross Area: 9.641 m<sup>2</sup> 103.77 ft<sup>2</sup> Net Aperture Area: 9.64 m<sup>2</sup> 103.77 ft<sup>2</sup>  
 Dry Weight: 0.0 kg 0. lb Fluid Capacity: 8.3 liter 2.2 gal  
 Test Pressure: 1103. KPa 160. psig

**COLLECTOR MATERIALS**

Frame: Aluminum and wood  
 Cover (Outer): None  
 Cover (Inner):

**Pressure Drop**

Flow		ΔP	
ml/s	gpm	Pa	in H <sub>2</sub> O

Absorber Material: Tube - PEX / Plate - Dark concrete tile Insulation Side: None  
 Absorber Coating: None Insulation Back: Radiant reflective membrane

**TECHNICAL INFORMATION**

Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta] Y INTERCEPT SLOPE  
 SI Units: η = 0.074 -2.87510 (P)/l 0.00755 (P)<sup>2</sup>/l 0.074 -2.780 W/m<sup>2</sup>·°C  
 IP Units: η = 0.074 -0.50645 (P)/l 0.00074 (P)<sup>2</sup>/l 0.074 -0.490 Btu/hr.ft<sup>2</sup>·°F  
 Incident Angle Modifier [(S)=1/cosβ - 1, 0° < β <= 60°]  
 K<sub>τα</sub> = 1 0.000 (S) 0.000 (S)<sup>2</sup> Test Fluid: Water  
 K<sub>τα</sub> = 1 0.00 (S) Linear Fit Test Flow Rate: 3.3 ml/s.m<sup>2</sup> 0.0048 gpm/ft<sup>2</sup>

**REMARKS:** This collector is integrated into the roof. The ratings listed above are based on the gross area of the tested collector. Collector weight and incident angle modifier were not measured.

September, 2011  
 Certification must be renewed annually. For current status contact:  
 SOLAR RATING & CERTIFICATION CORPORATION  
 400 High Point Drive, Suite 400 • Cocoa, Florida 32926 • (321) 213-6037 • Fax (321) 821-0910

[Return to Search](#)

# Hiring a Solar Contractor

## **18VAC50-22-30. Definitions of Specialty Services**

“Alternative Energy System contracting” (AES) means that service which provides for the installation, repair or improvement, from the customer’s meter, of alternative energy generation systems, supplemental energy systems and associated equipment annexed to real property. No other classification or specialty services provides this function. This specialty does not provide for electrical, plumbing, gas, fitting, or HVAC functions.

## **18VAC50-22-20 Definitions of License Classifications**

“Electrical Contractors” (ELE) means those individuals whose contracts include the construction, repair, maintenance, alteration, or removal of electrical systems under the National Electrical Code. This classification provides for all work covered by the National Electrical Code including electrical work covered by the alarm/security systems contracting (ALS), electronic/communication service contracting (ESC) and fire alarm systems contracting (FAS) specialties. A firm holding an electrical license is responsible for meeting all applicable tradesman licensing standards.

These contractors also install, maintain, or dismantle the following:

- Power systems for the generation and primary and secondary distribution of electric current ahead of the customer’ meter
- Pumping Stations and treatment plants
- Telephone, telegraph, or signal, systems for public utilities
- Water, gas, and sewer connections to residential, commercial, and industrial sites, subject to local ordinances.

“HVAC contractors” (HVA) means those individuals whose work includes the installation, alteration, repair, or maintenance of heating systems, ventilating systems, cooling systems, steam and hot water heaters, heating systems, boilers, process piping, and mechanical refrigeration systems, including tanks incidental to the system. This classification does not provide for fire suppression installations, sprinkler system installations, or gas piping. A firm holding a HVAC license is responsible for meeting all applicable tradesmen licensure standards. This classification may install backflow prevention devices incidental to work in this classification.

“Plumbing contractors” (PLB) means those individuals whose contracts include the installation, maintenance, extension, or alteration, or removal of all piping, fixtures, appliances, and appurtenances in connection with any of the following:

- Backflow prevention devices
- Boilers
- Hot water baseboard heating systems
- Hot water heaters
- Hydronic Systems

- Limited area sprinklers
- Process piping
- Public/private water supply systems
- Sanitary or storm drainage facilities
- Steam heating systems
- Storage tanks incidental to the installation of related systems

### **18VAC50-22-60 Requirements for a Class A license**

For every classification or specialty in which the firm seeks to be licensed, the firm shall name a qualified individual who meets the following requirements:

- Is at least 18 years old
- Has a minimum of five years of experience in the classification or specialty for which he is the qualifier
- Is a full-time employee of the firm as defined in this chapter or is a member of the firm as defined in this chapter or is a member of the responsible management of the firm
- Where appropriate, has passed the trade-related examination or has completed an education and training program approved by the board and required for the classifications and specialties listed below
  - Blast/explosive contracting
  - Electrical
  - Fire Sprinkler
  - Gas Fitting
  - HVAC
  - Plumbing
  - Radon Mitigation
  - Water well drilling
- Has obtained, pursuant to the tradesman regulations, a master tradesman license as required for those classifications and specialties listed in 18VAC50-22-20 and 18VAC50-22-30.

License Lookup and Disciplinary Actions - Windows Internet Explorer

http://www.dpor.virginia.gov/regulantlookup/selection\_input.cfm

Search Virginia.gov

Virginia.gov Online Services | Commonwealth Sites | Help | Governor

Virginia DPOR DEPARTMENT OF PROFESSIONAL AND OCCUPATIONAL REGULATION

Home > License Lookup and Disciplinary Actions

## LICENSE LOOKUP AND DISCIPLINARY ACTIONS

The Department of Professional and Occupational Regulation provides information regarding the licensee, complaint histories, and disciplinary actions involving licensees.

**Search [Disciplinary Actions Occurring Since April 1, 2002](#) (for those records appearing in License Lookup)**  
 Search by any word (similar to a Google search).

**Search License Records and Complaint History**  
 Search by name, license number, or zip code. To search for a specific license enter the ten-digit license/certificate number, OR search within one or more occupations by checking the boxes beside the occupation(s), entering the name (or partial name), and/or zip code. Please reference the [license lookup search instructions](#) for help on entering search criteria. To include special characters in the name (i.e. &), please reference the [license lookup search instructions](#).

Name:  Zip Code:  [US Postal Zip Information](#)

License/Certificate Number:

<p><b>APELSCIDLA</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Architects</li> <li><input type="checkbox"/> Professional Engineers</li> <li><input type="checkbox"/> Land Surveyors</li> <li><input type="checkbox"/> Land Surveyors B</li> <li><input type="checkbox"/> Land Surveyor Photogrammetrists</li> <li><input type="checkbox"/> Interior Designers</li> <li><input type="checkbox"/> Landscape Architects</li> <li><input type="checkbox"/> Apelscidia Businesses</li> </ul> <p><b>ASBESTOS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Asbestos Contractors and Labs</li> <li><input type="checkbox"/> Asbestos Individuals</li> <li><input type="checkbox"/> Asbestos Training Providers</li> </ul> <p><b>AUCTIONEERS</b></p>	<p><b>COMMON INTEREST COMMUNITIES</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Condominium, Cooperative, and Property Associations</li> <li><input type="checkbox"/> Standard Management Companies</li> <li><input type="checkbox"/> Provisional Management Companies</li> </ul> <p><b>CONTRACTORS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Contractor Businesses</li> <li><input type="checkbox"/> Individual Licenses and Certifications</li> </ul> <p><b>COSMETOLOGY</b>              (Cosmetology, Nail, Waxing, Hair Braiding)</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Cosmetology Individuals</li> <li><input type="checkbox"/> Cosmetology Businesses</li> <li><input type="checkbox"/> Cosmetology Schools</li> </ul> <p><b>ESTHETICS</b></p>	<p><b>ONSITE SEWAGE SYSTEM PROFESSIONALS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Soil Evaluators</li> <li><input type="checkbox"/> Operators</li> <li><input type="checkbox"/> Installers</li> </ul> <p><b>OPTICIANS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Opticians</li> </ul> <p><b>POLYGRAPH EXAMINERS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Polygraph Examiners</li> </ul> <p><b>REAL ESTATE</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Real Estate Individuals</li> <li><input type="checkbox"/> Real Estate Businesses</li> <li><input type="checkbox"/> Real Estate Schools</li> </ul> <p><b>REAL ESTATE APPRAISERS</b></p>
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http://www.dpor.virginia.gov/dporweb/dpor\_forms.cfm

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Contractor Business License - Windows Internet Explorer

http://www.dpor.virginia.gov/regulantlookup/BusContractorDetail.CFM?CFID=8516352&CFTOKEN=30888592&Im=2705037710

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DEPARTMENT OF PROFESSIONAL AND OCCUPATIONAL REGULATION

Home > Contractor Business License

### Contractor Business License

BUSINESS NAME:		SOLAR SERVICES INC
TRADING NAME:		
ADDRESS:		877 SEAHAWK CIR SUITE 101 VIRGINIA BEACH, VA 23452-0000
BUSINESS TYPE:		CORPORATION
CLASS OF LICENSE:		A
CLASSIFICATIONS/SPECIALTIES:		ALTERNATIVE ENERGY SYSTEM, BUILDING, ELECTRICAL, GAS FITTING, HVAC, PLUMBING
REGISTRATION NO.:		2705037710
INITIAL CERTIFICATION DATE:		APRIL 21, 1997
EXPIRATION DATE:		APRIL 30, 2013

**Open Complaints: None**

"Open Complaints" reflect only those complaints for which a departmental investigation has determined that sufficient evidence exists to establish probable cause of a violation of the law or regulations. Only those cases that have proceeded through an investigation to the adjudication stage are displayed.

**State law prohibits the disclosure of any information about open complaints** [Code of Virginia Section 54.1-108]. Members of the public may review official records and obtain copies only after a complaint investigation is closed.

**Closed Complaints: None**

"Closed Complaints" reflect complaints closed since 1990. Cases closed without disciplinary action are purged after three years in accordance with DPOR's record

Done

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## SHW Performance

14 = SITE CODE # SOLAR WATER HEATER PERFORMANCE MONITORING PROGRAM - MONTHLY SUMMARY  
12:02 PM TUE., 9 MAR., 1983

**METERS**

RAY SIZE = 80 sq.ft., Fr'ta = .67, Fr'UL = 1.26  
MUTH = 0deg U of S, TILT = 40 deg from horiz.  
RAGE (gal): SOLAR = 120, BACK-UP = 52  
AR EQUIP (WATT): PUMP = 170, CONTR = 2, VALVE = 0  
TEM TYPE - CLOSED LOOP, CITY CODE = 152  
TEM COST LESS TAX CREDIT = 2280, DESIGN OCCUP. = 5  
T EXCHANGER TYPE - COUNTERFLOW, EFFECTIVENESS = .85

**DEFINITIONS**

PKWH - TOTAL KWH PURCHASED RELATED TO SOLAR ENERGY  
SKWH - TOTAL KWH OF PARASITICS OF SOLAR HEATER  
IU TEMP - TEMP OF INCOMING GROUND WATER  
TKWH/DAY - 3.10 KWH/DAY STAND-BY LOSS CONV. TANK  
SYS. STAT - SYSTEM STATUS, SEE TABLE A  
BACK-UP % TIME CIRCUIT BREAKERS TO ELEMENT IS ON  
SSF - % OF POSSIBLE SOLAR SUPPLYING HOT WATER

TE	GAL/ DAY	PKWH/ MONTH	SKWH/ MONTH	PUMP HR/D	IU TEMP	\$/S/ KWH	ACTUAL OCCUP.	SYS. STAT	BACK-UP % AVAIL	KWH/MO SAVED	\$/S/MO SAVED	SSF
'82	157.	313.1	33.0	6.1	61	.0467	4.0	A	100%	592	27.65	66%
'82	161.	221.2	37.6	7.0	66	.0522	4.4	A	100%	732	38.24	77%
'82	126.	107.2	31.7	5.9	72	.0732	4.0	A	100%	532	38.90	84%
'82	99.9	63.7	37.0	6.9	74	.0732	4.2	A	100%	446	32.67	88%
'82	120.	78.5	33.6	6.2	75	.0732	5.0	A	100%	508	37.20	87%
'82	152.	159.7	29.9	5.5	72	.0717	5.0	A	100%	588	42.17	79%
'82	160.	301.4	24.9	4.5	63	.0500	5.0	A	100%	584	29.19	66%
'82	147.	367.4	22.3	4.0	58	.0500	5.0	A	100%	513	25.64	59%
'82	163.	569.5	18.0	3.2	51	.0500	5.0	A	100%	481	24.07	46%
RAGE	145.	242.4	29.8	5.5	66		4.6		100%	553	32.86	73%
AL		2182.	268.1							4976	295.73	

\*\*\*\*\*  
KWH-SAVED TO DATE = 4976  
\$/S SAVED TO DATE = \$295.73  
SOLAR SAVINGS FRACTION (SSF) = 70%  
SIMPLE RETURN ON INVESTMENT 17%  
\*\*\*\*\*

COMMENTS: TWO PUMP SYSTEM  
\*\*\*\*\* LOAD MANAGEMENT DEVICE INSTALLED BY UTILITY 7/22/82

REVIEW COPY

ANALYSIS OF FIELD TEST DATA FROM DOMESTIC SOLAR WATER HEATING IN THE SOUTHEAST UNITED STATES  
Covering Analysis Through May 1982

William B. Jones  
Robert A. Jones

July 1982

RESOLVING  
ALABAMA, MISSISSIPPI

NOTE: The information contained herein is being furnished in support of the research and development activities of the Southeastern States Solar Water Heating Demonstration Program. The views expressed herein do not necessarily reflect the views of the U.S. Department of Energy. The U.S. Department of Energy is not responsible for the accuracy or completeness of the information contained herein.

U.S. Department of Energy

Wells Fargo

**Solar Electric Power** (continued from page 3)

great investment. California, for instance, has aggressive subsidies that cover nearly half the cost of a system, as well as a 7.5% tax rebate. For California homeowners with electricity bills over \$100, a solar system financed with tax-advantaged\* home equity funds could even start paying for itself immediately.

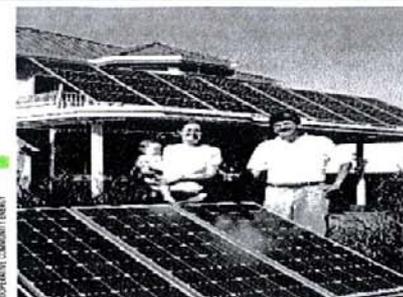
Instead of paying the utility company every month you'll be paying down your home equity account and rebuilding your equity.

But that's not the only financial advantage. When it comes to home value, a solar power system may be your best "remodel" option. Based on a recent study

by ICF Consulting (funded by HUD and the EPA), energy-saving measures such as solar can add \$20 of home value for every \$1 of yearly energy cost savings. That makes an already bright idea really shine.

**How to get started**  
Many state, federal, and industry resources exist to help you evaluate solar providers. A good place to start is "A Consumer's Guide to Buying a Solar Electric System" by the Department of Energy's National Renewable Energy Laboratory (NREL). You can download it for free from the NREL web site (see online resources below).

Solar providers can be found under *Solar Products—Dealers and Services* in the Yellow Pages. These are licensed contractors specializing in the installation of solar electric systems. They can help you:



ECONOMIZING CONSUMER ENERGY

- Evaluate whether a solar investment is right for your home.
- Perform an on-site inspection to give you an accurate recommendation of your solar needs and deliver an estimate.
- Assist you by filing required paperwork for any building permits
- Help you secure local, state, or federal tax breaks or subsidies.

**Selecting a provider**

When selecting a solar provider, use the same criteria as you would for hiring any contractor:

- Try to get at least 2 or 3 estimates for comparison
- Make sure the provider is licensed and bonded
- Ask for customer references on past installations.



\*Consult your tax advisor.

Visit [wfsolar-resource.net](http://wfsolar-resource.net) for direct links to these and other solar electric power resources.

**California Energy Commission** <http://www.consumerenergycenter.org/>  
Click on the renewable energy bar to find useful consumer information guides that can be downloaded:

- Buying a PV Solar Electric System—A Consumer's Guide.
- A Guide to Photovoltaic (PV) System Design and Installation.

**National Renewable Energy Laboratory (NREL)** <http://www.nrel.gov/>  
Download "A Consumer's Guide to Buying a Solar Electric System." (PDF file at [www.nrel.gov/ncpv/pdfs/26591.pdf](http://www.nrel.gov/ncpv/pdfs/26591.pdf)) It's an excellent overview that can help you decide if solar electric is right for you.

**Database of State Incentives for Renewable Energy (DSIRE)**  
<http://www.dsireusa.org/>

Find out what subsidies, tax incentives, and incentives are available for solar (and other renewable) energy systems in your state.

**PV Watts - Solar Energy Calculator**  
[http://rredc.nrel.gov/solar/codes\\_algs/PVWATTS/version1/](http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version1/)

This online calculator allows you to estimate the potential electricity generated by a solar electric system anywhere in the U.S.

**Increase your line or convert your line to a fixed-rate loan.**

Call **1-800-482-3348** to speak with a Wells Fargo representative on how you could better manage the equity built up in your home. Or visit [wellsfargo.com](http://wellsfargo.com).

## Thank You

Richard Good, President, and  
Nathan Farley, Sales Consultant  
Solar Services, Inc.

[Richard@solarservices.com](mailto:Richard@solarservices.com)

[Nathan@solarservices.com](mailto:Nathan@solarservices.com)

757-427-6300

# Geothermal Heat Pumps

Parrish Services, Inc.

[www.parrishservices.com](http://www.parrishservices.com)

Linda Couch

Chief Operating Officer

John Alexy

HVAC Service Manager



**Renewable Energy Systems and Green  
Power**

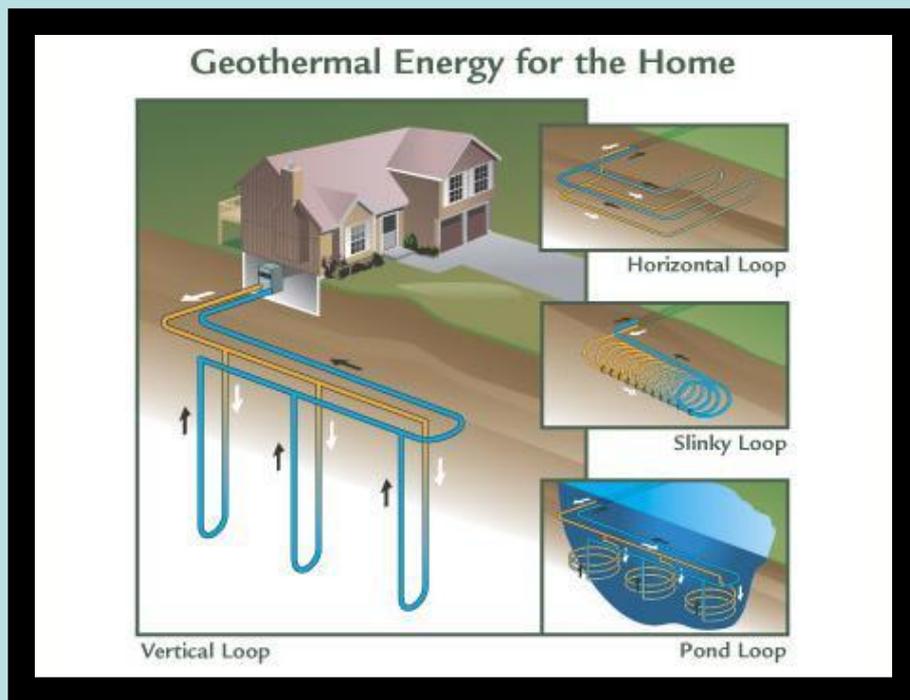
**Saturday, September 24, 2011**

**Polk Elementary School, Alexandria VA**

## Tell me about geo!

Geothermal heat pumps are sometimes referred to as ground source heat pumps, geoexchange systems, or water source heat pumps.

Geothermal heat pumps are a proven technology. The concept was developed in the 1800's, and it has been commercialized since the 1940's.



The geothermal system includes three subsystems: the earth connection (“loop”); the heat pump; the distribution system.

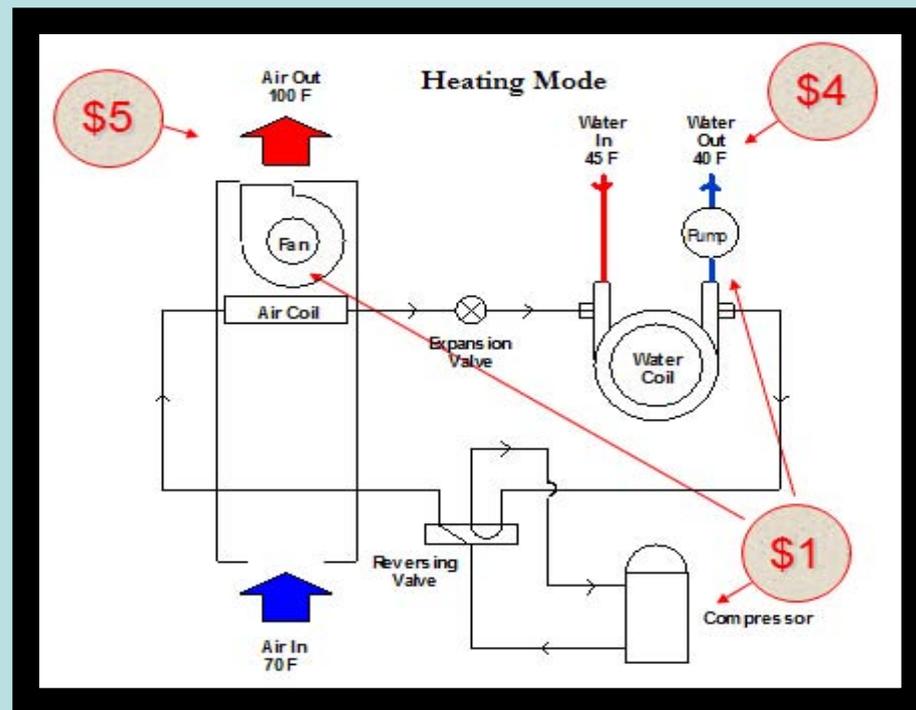
Geothermal heat pumps have gained popularity in the last few years because they offer homeowners lower utility bills, greater comfort, and increased system life. Tax credits and rebates didn't hurt, either!

## Geothermal Heat Pump Technology

A geothermal heat pump exchanges heat between air and water; it uses the same principles as your refrigerator.

Taking 1 unit of energy to operate the compressor and fan, the geothermal heat pump:

- moves 4 units of heat from the water
- delivering 5 worth of heat into the air



The optional desuperheater takes excess heat from the unit and uses it to heat water inside a domestic water heater tank increasing the overall energy efficiency.

## Comfort and ease of use

Compared to conventional systems, geothermal heat pumps:

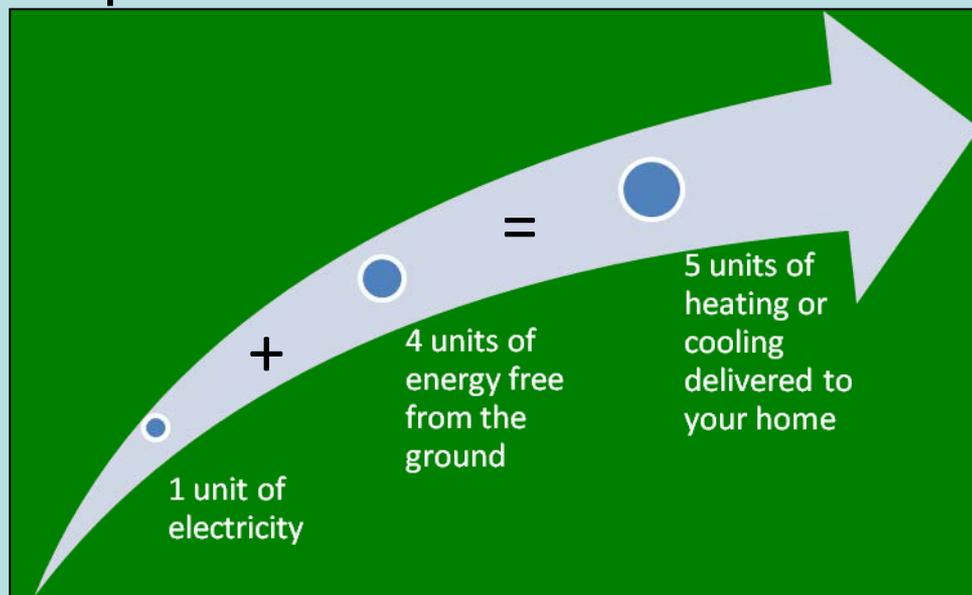
- They usually have no outdoor unit, so they're more attractive, save space, and need less maintenance
- Offer greater consistency in heating and cooling
- Are more reliable, so they'll be running when you need them

- Are more quiet (no outdoor unit, improved blower technology and insulated cabinets)
- Are safer with no chance of carbon-monoxide poisoning



## Environmental considerations

- Geothermal systems are the most energy efficient heating and cooling technology available – up to 600%.
- The loop materials will last *decades*, and the material is commonly recycled.
- You can opt for fluid in the loop that is non-toxic and biodegradable.
- Installing a system is the equivalent of planting 750 trees or removing two cars from the road.
- No harmful emissions or greenhouse gasses.



## Financial considerations

- Geothermal units have lower operating costs. We expect owners to save 45-70% of their *total* utility bills.
- The dollar value of that savings grows every year as inflation and other factors affect utility prices.
- Geothermal heat pumps last twice as long as conventional, and when they are replaced, it will be at only half the cost because the loop is still viable.
- An optional desuperheater will save on water heating.
- The marketability and resale value of your home will be increased.
- Visit [dsireusa.org](http://dsireusa.org) for a list of all energy related incentives including the 30% federal tax credit.



## Common questions and concerns

- “My yard is too small.”
- “ I heard I need a well. What if I don’t have one?”
- “Will the indoor unit fit in my house?”
- “I don’t think my HOA will let me have one.”
- “It’s too expensive.”
- “The payback period is too long.”
- “I might sell my house.”
- “My in-laws have a heat pump and I don’t like them (oh...heat pumps, that is...)”
- “I don’t want to have to replace all of my systems”
- “I just want to know, how much is it?”
- “I don’t have the cash for a new system, and I don’t want to finance one.”
- “Can I use one with my radiant floor/spa/pool/irrigation system/etc.?”
- “What about when it’s *reeeeeally* cold – how well does it work?”

## Buying a geothermal system

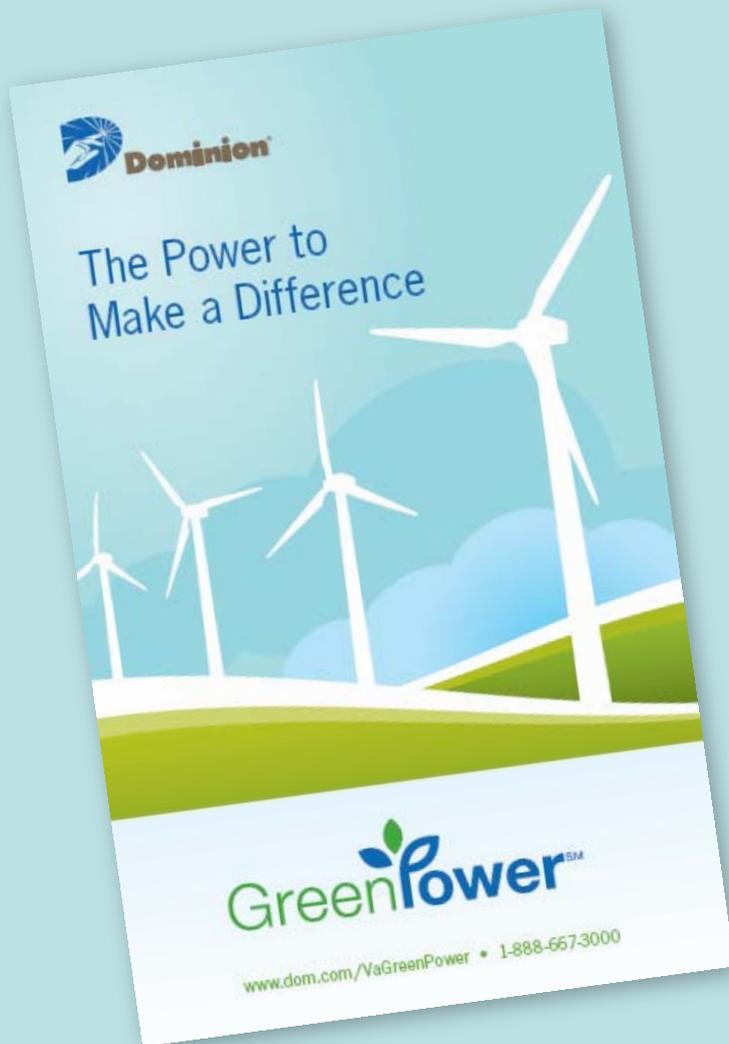
- According to the EPA, up to 30% of your system efficiency is directly attributable to the quality of the system design and installation, so *thoroughly* vet your prospective contractors.
- Use the resources available. There are many great articles and videos. Be green, and we'll email you a list:
  - Leave your email address on the sheet today
  - Email us at [geo@parrishservices.com](mailto:geo@parrishservices.com)
- If you're looking for a book, we would recommend *The Smart Guide to Geothermal* by Donal B. Lloyd

Thank you

Linda Couch, Chief Operating Officer  
Parrish Services Inc.

[lcouch@parrishsvcs.com](mailto:lcouch@parrishsvcs.com)

703-330-5748



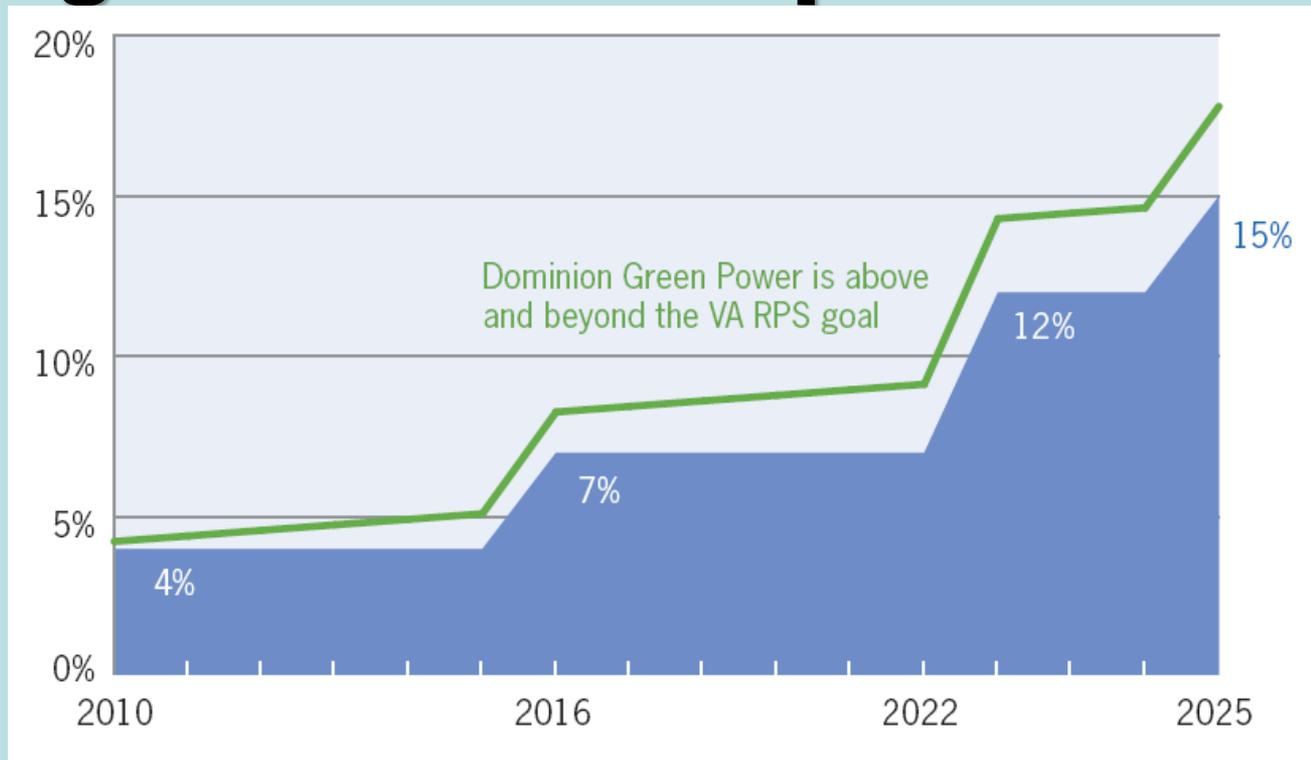
## Dominion Green Power

**Sarah Bodsford**  
**Northern VA Outreach Coordinator**  
**Dominion Green Power program**

## Dominion Green Power

- What is the Dominion Green Power program?
- How does it work?
- What difference am I making?
- How to enroll in Dominion Green Power?

# Customer purchases are above and beyond Dominion's renewable energy generation and purchases



# What is it?

# The Dominion Green Power Program

## What is it?

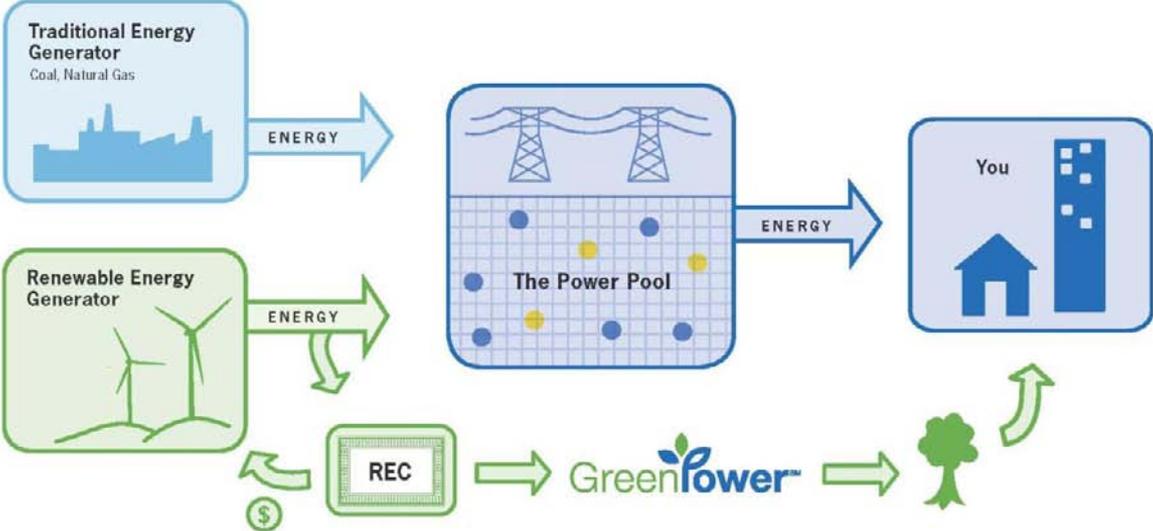
- A voluntary option available to Dominion Virginia Power customers.

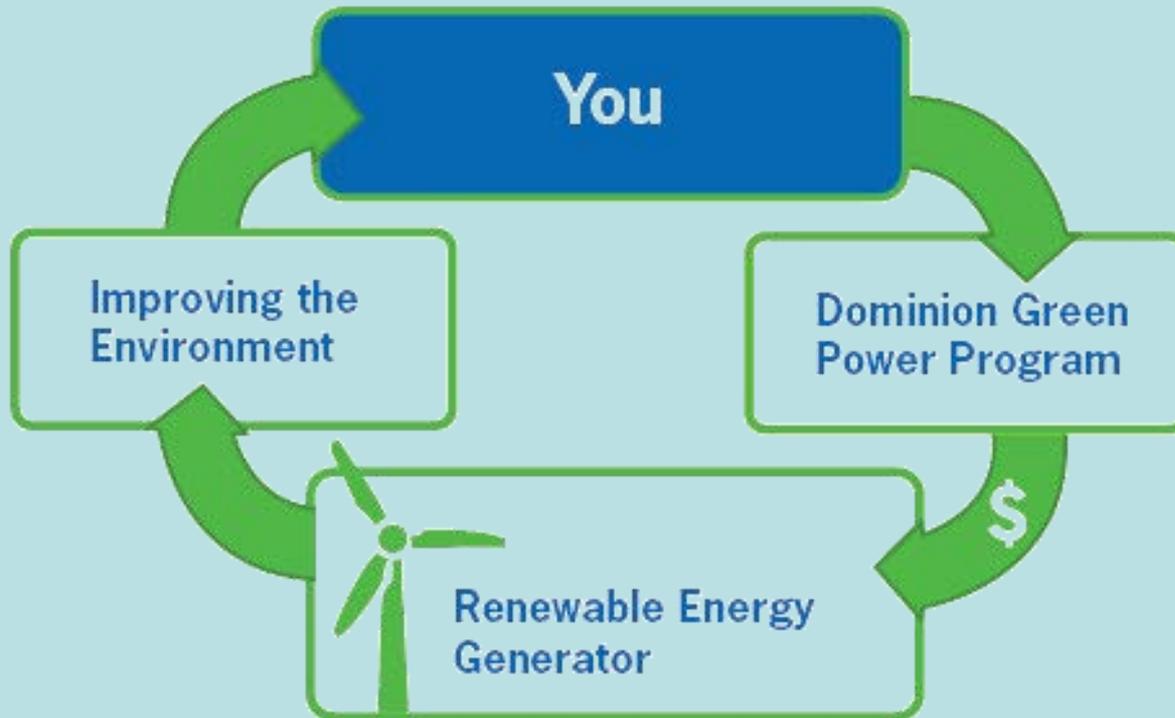
## What does it do?

- It allows enrolled customers to conveniently support renewable energy by adding an additional amount to their monthly bill.

# How does it work?

### How Dominion Green Power Works





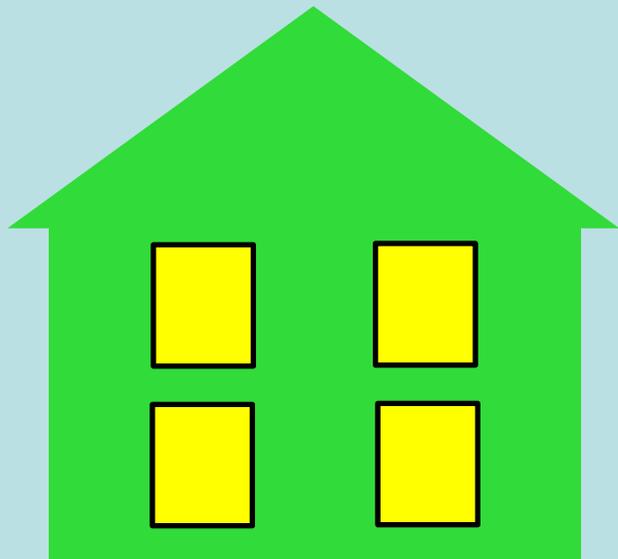


## Renewable Energy Sources

- **wind, solar, and biomass**



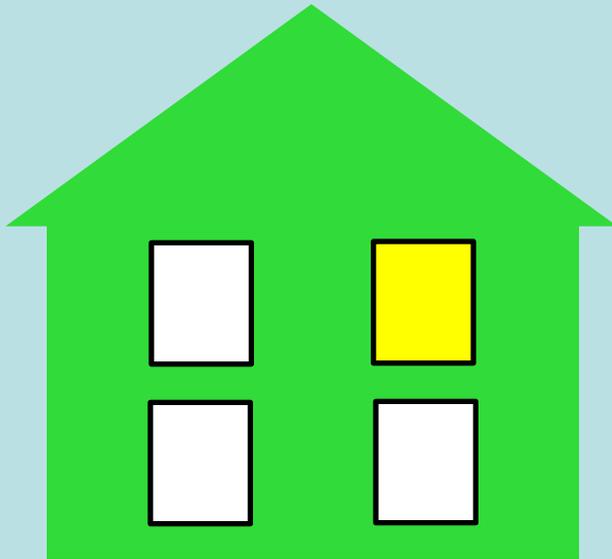
# Two Customer Options



## 100% Option

- Customers can match 100% of their electricity use each month with RECs for an additional **1.5 cents per kilowatt hour**.
- This will cost the typical residential customer (who uses 1,000 kwh/month) \$15 more per month. The cost varies each month depending on how much electricity they use.

# Two Customer Options



## Block Option

- Customers can purchase RECs in any \$2 fixed monthly increment to match a portion of their electricity use.
- Each additional \$2 block supports 133 kilowatt hours of renewable energy.

# Green-e Energy Certification

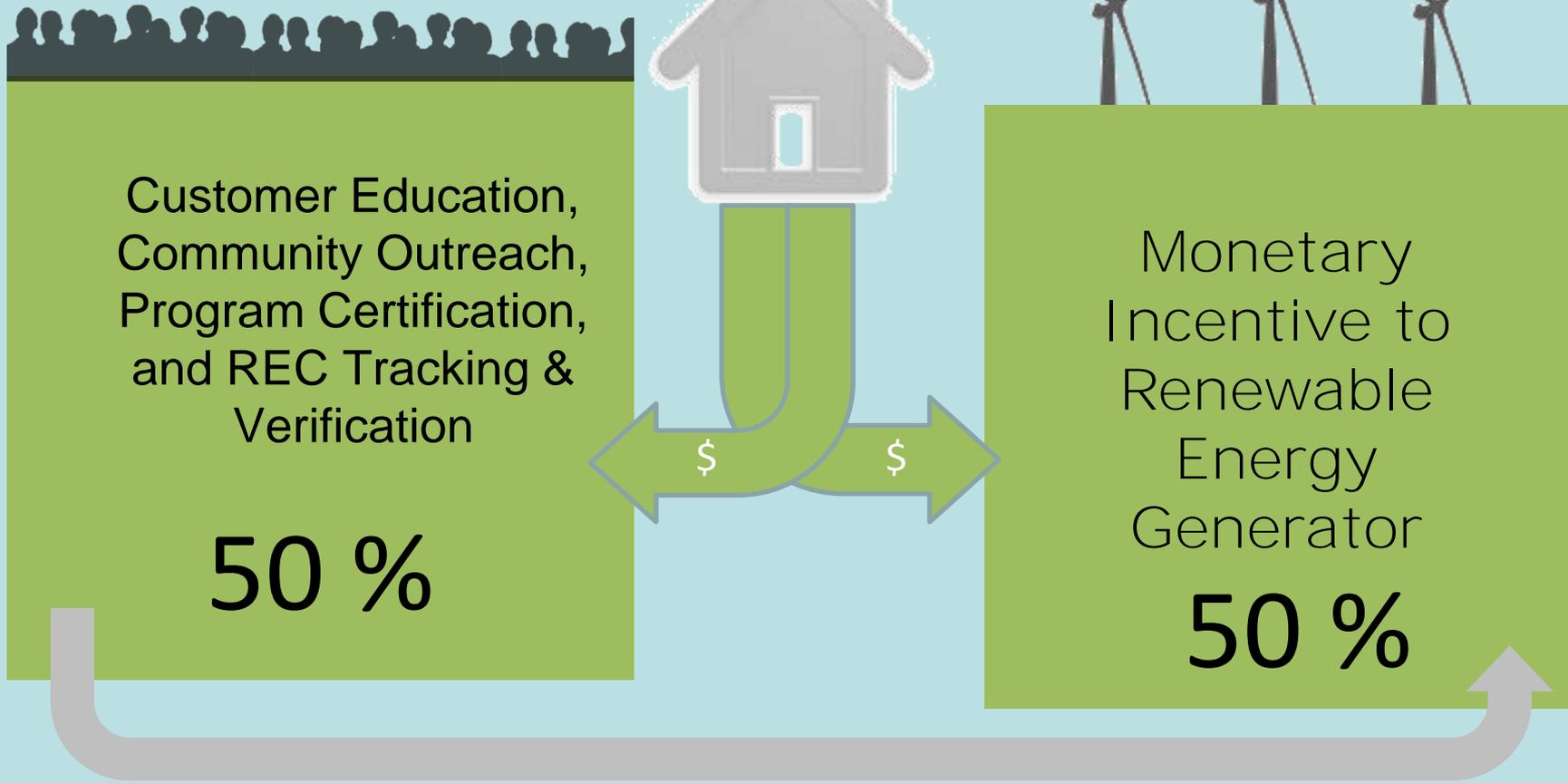


- Certification comes from a third-party non-profit consumer protection organization
- Customers are supporting new renewable resources
- There has been no double selling: each customer is the only one that can claim the benefits of the renewable energy s/he bought
- Each purchase is above and beyond renewable energy that was built for law or mandate, helping expand the production of renewable energy in the U.S. and Canada
- Claims made about the program are accurate

# Where does the customer's money go?

**Dominion does NOT make a profit on  
this program!**

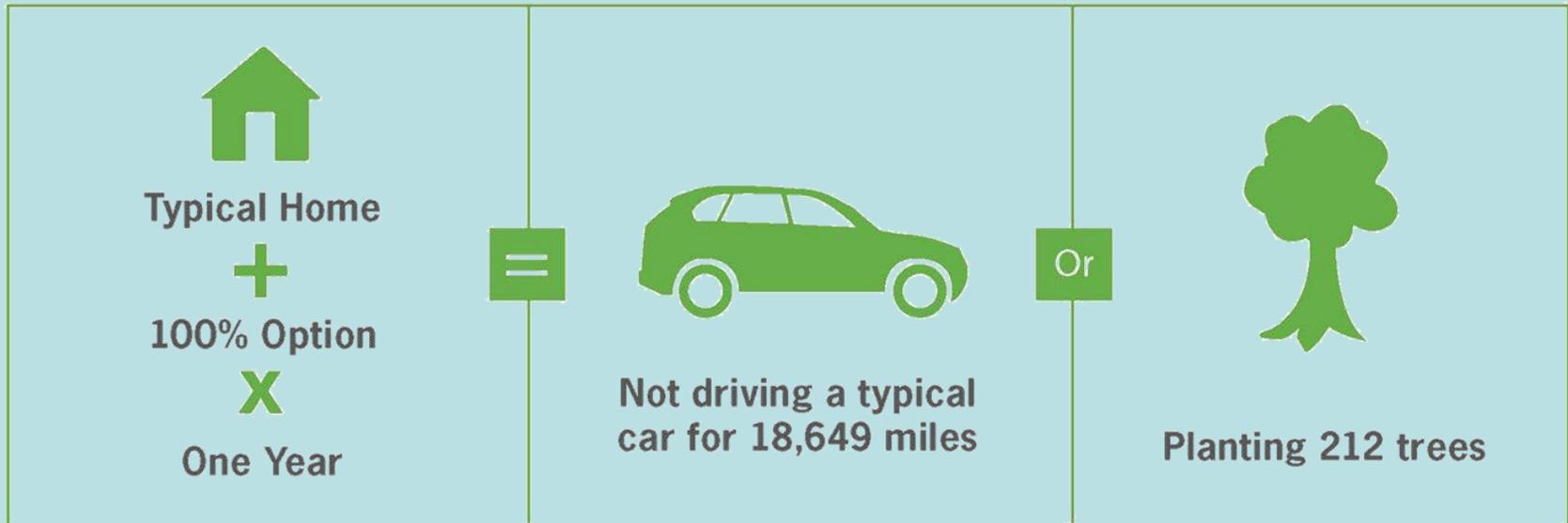
# Where does the money go?



What difference do I make  
when I enroll in  
Dominion Green Power?

# What does it mean...

Enrolled customers can claim environmental benefits:



Based on average monthly electricity use of 1,000 kWh  
Annual average based upon EPA estimates (<http://epa.gov/grnpower>)



“We value the environment so we wanted to offset our energy use with renewable energy. Dominion Green Power was the easiest way to do that.”

“The program is a really easy way to support green initiatives without putting solar panels on the roof or taking on a project like that- this has the same impact but it’s a lot easier and cheaper”

-Eric McKay,  
Hardywood Park Brewery

## Every customer that enrolls:

- Helps improve the environment for us all!
- Helps boost our economy and create more jobs!
- Helps make our country stronger by fostering the development of new renewable energy sources!



# How do I enroll in the program?

# How do I enroll?

- [www.dom.com/VaGreenPower](http://www.dom.com/VaGreenPower)
- Brochures/Outreach
- 1-866-DOM-HELP  
(1-866-366-4375)



**Thank You!**

**Sarah Bodsford**  
**Northern VA Outreach Coordinator**  
**3Degrees**  
**Dominion Green Power program**  
**571-338-3086**  
**[sbodsford@3degreesinc.com](mailto:sbodsford@3degreesinc.com)**

## **Incentives for Solar System and Geothermal Systems**

### **Local Program**

- City of Alexandria solar energy equipment real estate tax exemption (residential & commercial)

### **Virginia Programs**

- Rebates for geothermal heat pump equipment purchased and installed on or after March 26, 2010
  - Rebates can be redeemed for 20% of the documented costs of qualifying geothermal heat pumps, up to \$2,000 per residential property address.

### **Federal Programs**

- Tax credits for residential efficiency upgrades (10% with \$500 cap )
- Tax credits for solar water heating and PV system installations (30% with no cap)
- Tax credits for geothermal, fuel cells, and small wind systems (30% with no cap)

**FIND OUT MORE AT ALEXANDRIA'S GREEN BUILDING RESOURCE CENTER (<http://alexandriava.gov/gbrc>)**

## Workshop 5 Resource Links

[www.alexandriava.gov/gbrc](http://www.alexandriava.gov/gbrc)

[www.energystar.gov](http://www.energystar.gov)

[www.eere.doe.gov](http://www.eere.doe.gov)

Dsireusa.gov

[www.thesolar411.com](http://www.thesolar411.com)

www.Solarservices.com

www.parrishservices.com

www.dom.com/VaGreenPower

www.smartbuildingdirectory.org

[www.vsbn.org](http://www.vsbn.org)