

Sector Focus:

Solar Water Heating in Multi-family & Affordable Housing Buildings: Lessons from the field

Renewable Heating & Cooling Webinar Series

U.S. Environmental Protection Agency

November 13, 2012

1:00 PM - 2:30 PM

Agenda

- 1:00 – 1:10 pm **Welcome, James Critchfield, U.S. EPA**
- 1:10 – 1:30 pm **Dr. Benjamin, T. Gravely, PhD, President, Holocene Technologies**
Overview: Solar Hot Water Opportunities
- 1:30 – 1:50 pm **Mr. Harry Richter, Assc. AIA, CMCA, High Rise Consulting**
4600 Connecticut Avenue Condominiums, Washington DC
- 1:50 – 2:10 pm **Ms. Nina Janopaul, CEO, Arlington Partnership for Affordable Housing**
Columbia Grove, Arlington VA
- 2:10 – 2:25 pm **Question & Answer Session**

Speaker

Holocene Technologies



Ben Gravely

President

ben.gravely@holocene-energy.com

Cell: 919-818-1879

Blog: www.solarhotwater-systems.com

- Education in Physics, NC State Univ. (NCSU)
- Early pioneer in solar system design and manufacturing (1977-present)
- Several thousand systems installed, covering residential, commercial, military, institutional
- Co-founder of NC Sustainable Energy Association
- A founder of NC Solar Center at NCSU
- Lecturer on solar system design

Solar Thermal Energy

A Review of Solar Hot Water Systems for Multi-Family Buildings

Ben Gravely - Holocene Technologies
Blog <http://www.solarhotwater-systems.com>



- Common Solar System Types & Applications
- Challenges & Opportunities
- Market Conditions & Trends



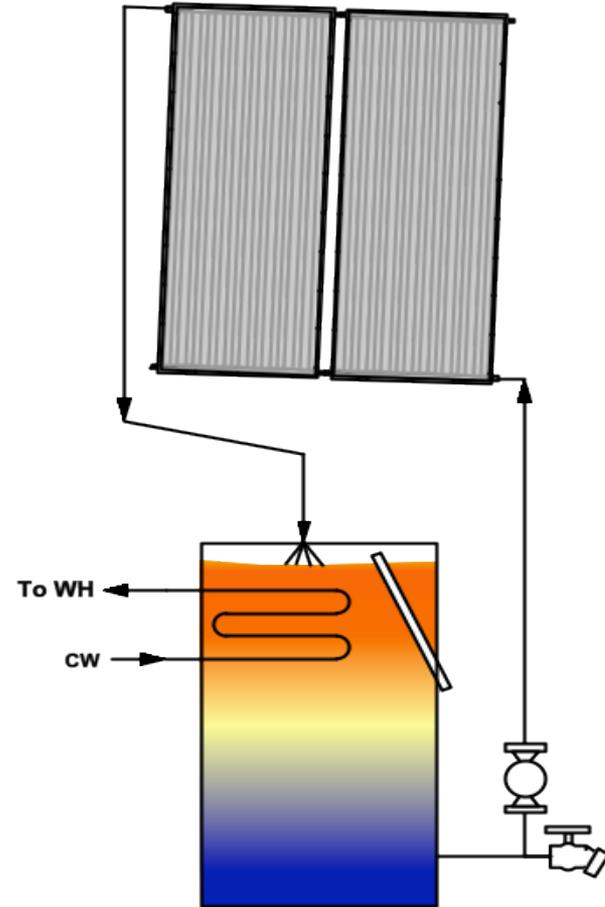


How it works Non-pressurized Drainback System

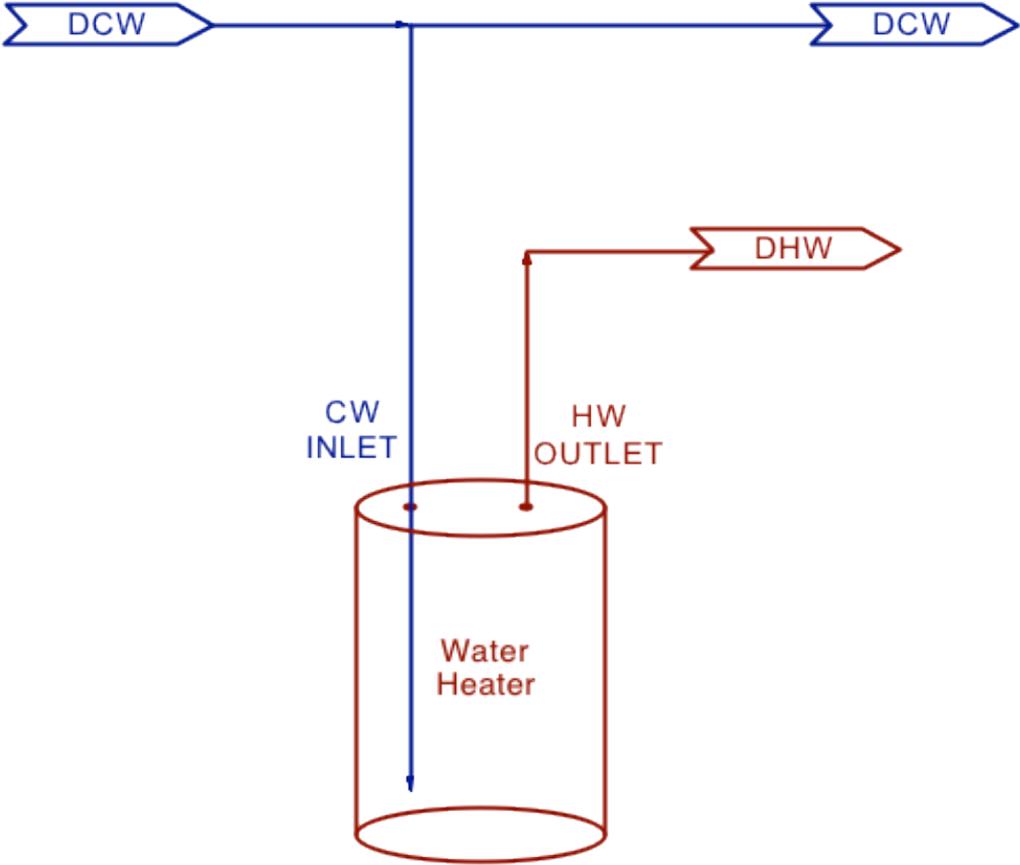
Start with

- Collectors
- Non-Pressurized tank
- Load Side Exchanger
- Pump

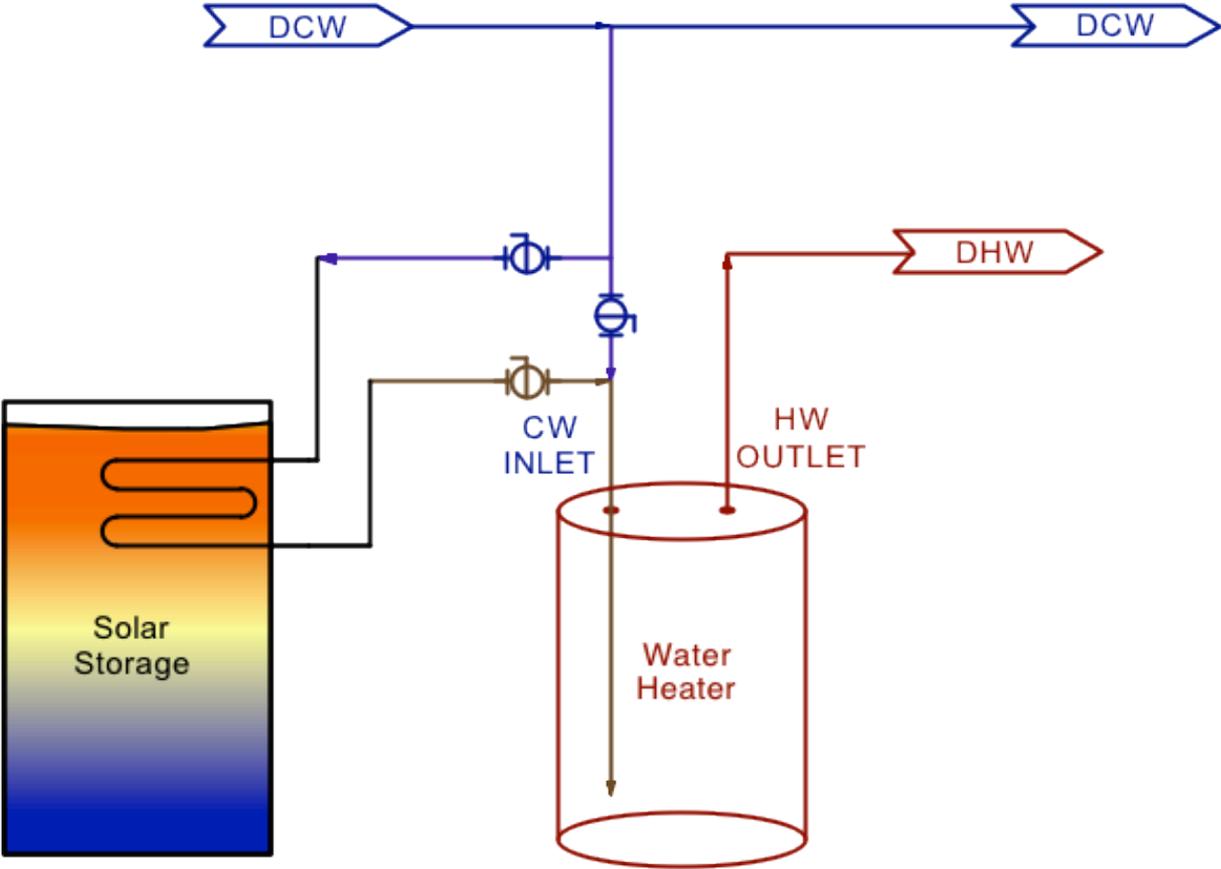
Power failure is normal
operating mode



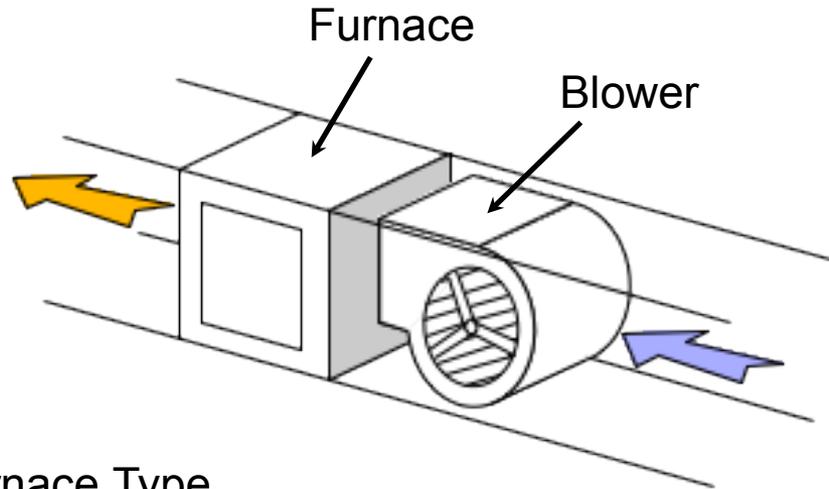
Applications DHW



Applications DHW

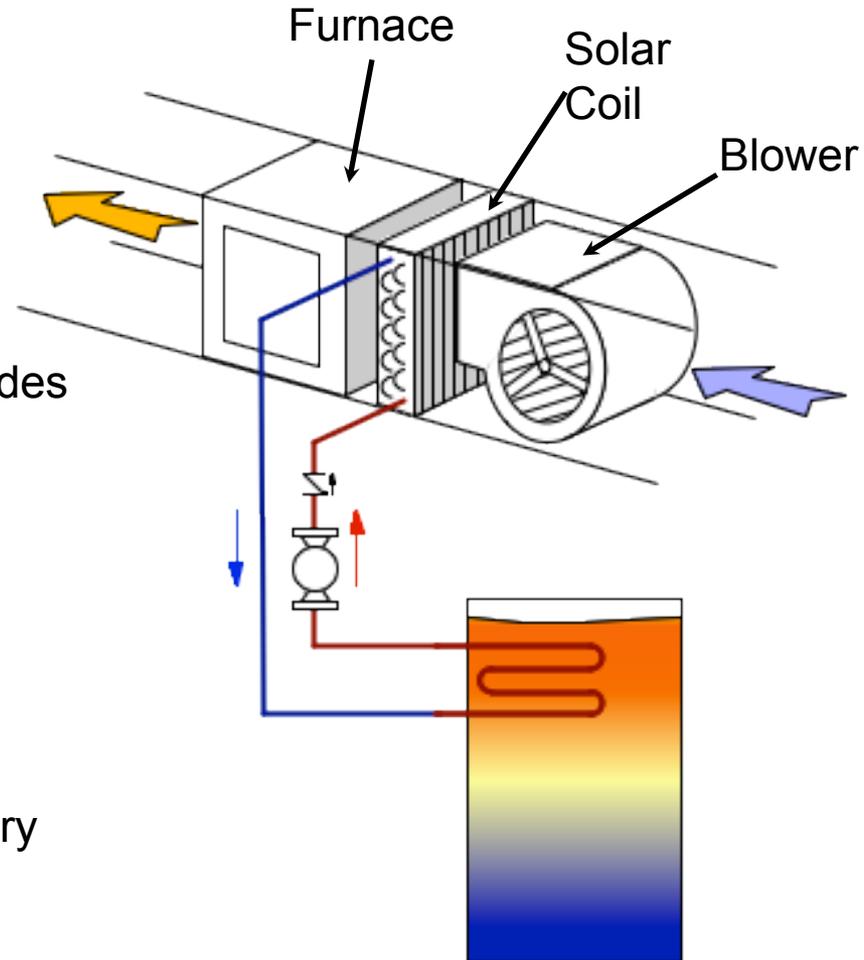


Applications SH - Forced Air



- Any Furnace Type
- Gas
 - Oil
 - Heat Pump with
Electric Backup

Applications SH - Forced Air

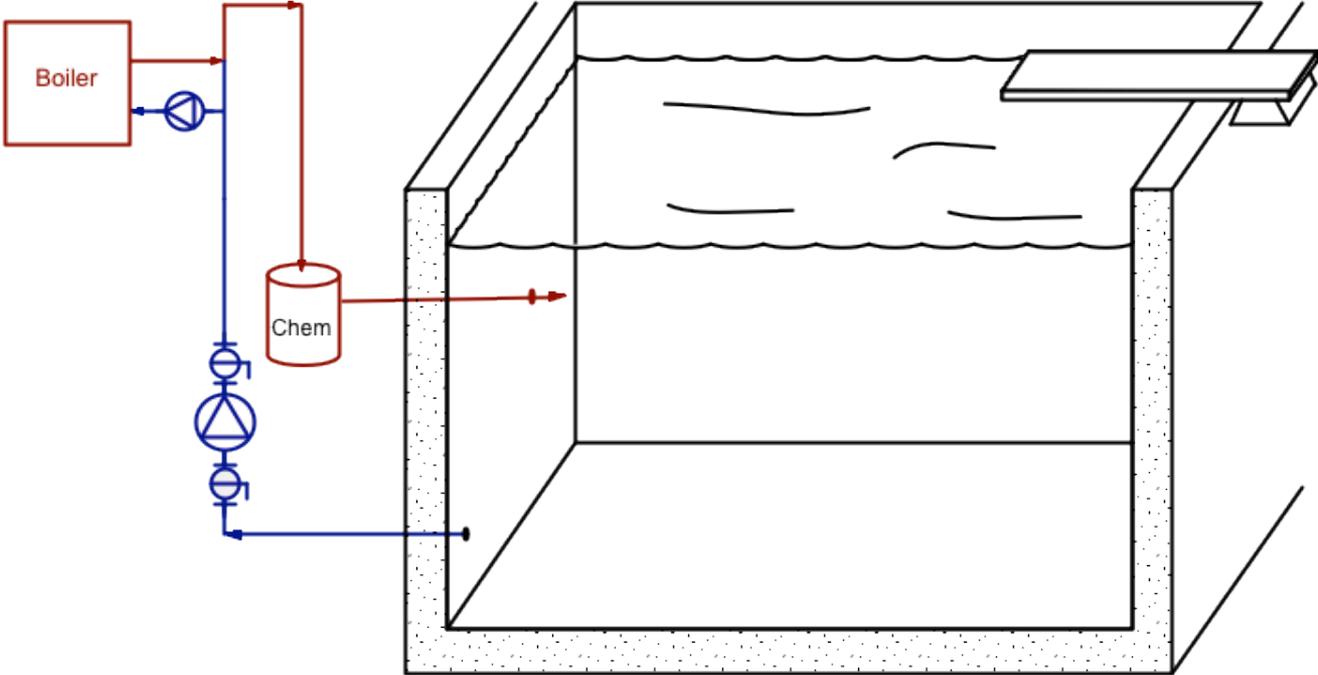


Three operational modes

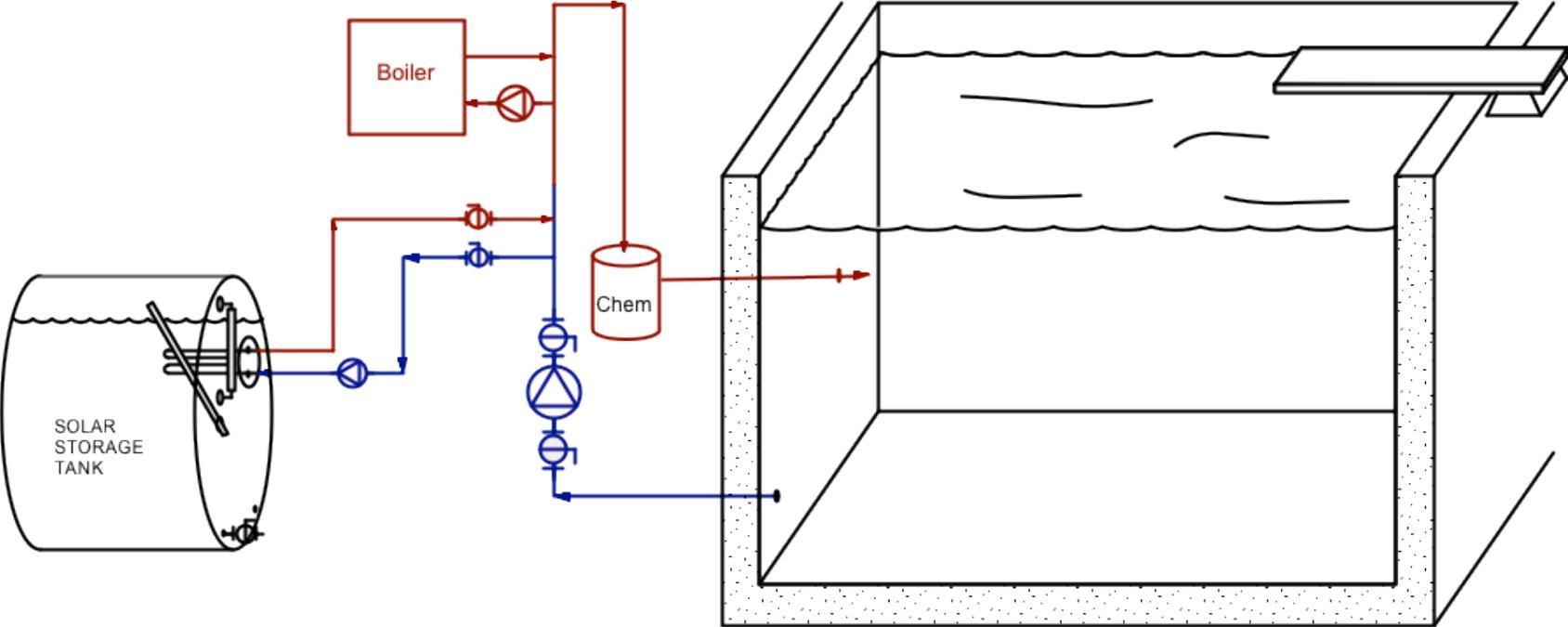
- Solar Only (hot)
- Solar Assist (med)
- Solar Cut Out (cold)

Specify Coil for
Low Temp Delivery

Applications Pool Heating



Applications Pool Heating



Challenges & Opportunities

Architectural/Engineering

- Find good solar thermal application (or two, or three)
- Simple architectural fit to existing facility?

Collector location - south facing

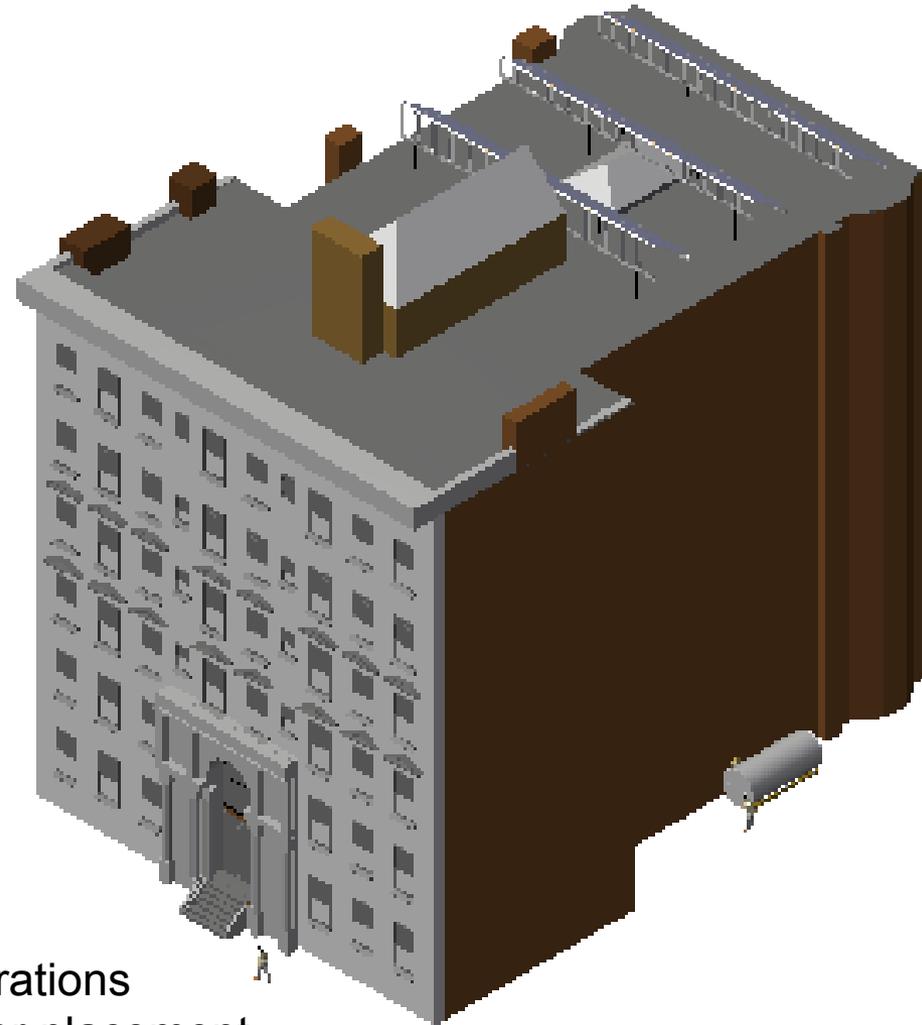
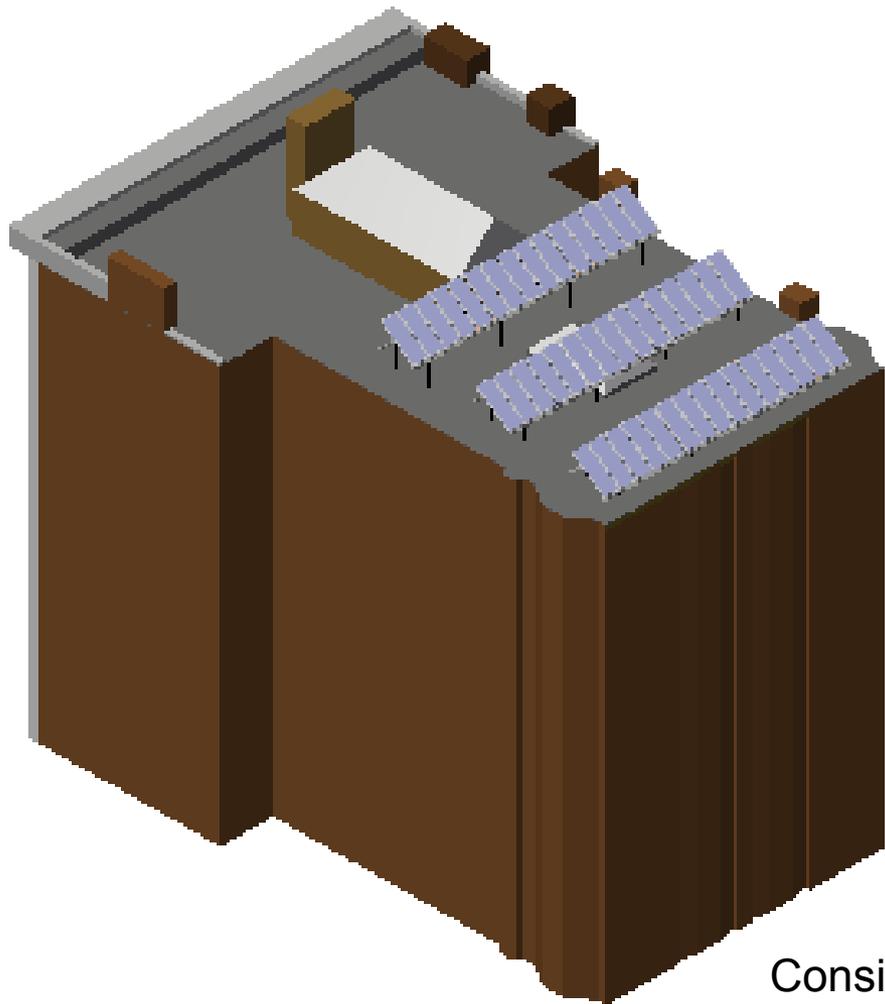
Storage tank location

Use location - mechanical room

- Can plan a good fit in new facility.

Lot of ways to
skin a cat

Example: 5 Story Building in Boston



Considerations

- Collector placement
- Tank placement
- Piping runs

Tank Placement

- Inside equipment room
- Enclosure outside equipment room



Market Conditions & Trends - The Wild Wild West

Pros

- Systems are proven and durable
- Design & trade skills are available
- Various incentives - state, federal, utility
- Growing financing market

Cons

- Lack of qualified Design & Installation professionals
- Lack of uniform codes and regulations
- Varying incentives from state to state
- Long term political emphasis on renewables uncertain
- Financing infrastructure not well developed

Conclusion: Deal with experienced people

Economics

- Current and future cost of energy - First Order Estimates

Example: Solar output = 8 MBtu/collector

Installed cost/coll = \$4500

System lifetime = 20 years

Results: Lifetime energy = 160MBtu/coll

Simple energy cost over lifetime = \$28.125/ MBtu

= \$0.09/kWh

Compare with existing fuel cost of gas, oil, electric (\div by efficiency)

e.g. 80% efficiency = 1.25X fuel cost

65% efficiency = 1.53X fuel cost

- Need threshold energy value for go ahead.

Speaker

4600 Connecticut Avenue Condominiums



Harry Richter, Assc. AIA, CMCA

High Rise Consulting, LLC

HarryRichter@callHighRise.com

- Following a 22 year career managing high rise residential buildings, Harry is now a management consultant focusing on facilities operations, the built environment, and sustainable practices.
- At 4600 Connecticut Harry found 100% financing for the solar-thermal system, allowing the condominium to realize savings from day one with no capital investment.

EPA Webinar: Solar Water Heating

Multifamily Building Application at 4600 Connecticut Avenue

Harry Richter, Assc. AIA, CMCA
High Rise Consulting
HarryRichter@CallHighRise.com
703.606.9889

About 4600 Connecticut Avenue

- 9-story condominium in northwest Washington, DC
- 267 units; 401 residents
- Central boiler system for domestic hot water, space heating, and laundry
- Roof type: Ballast
- Solar system completed in March 2012



The Decision to Go Solar

- Master-metered for natural gas; solar savings directly realized by each resident's condo fees
- Approval for solar by condo board vote
- Skyline Innovations selected as project financier
 - No capital outlay power purchase provider
 - Responsible for financing, development, and O&M
 - Payment only for solar hot water used, not all generation
 - Maintained roof warranty
- Solar Energy Services performed installation

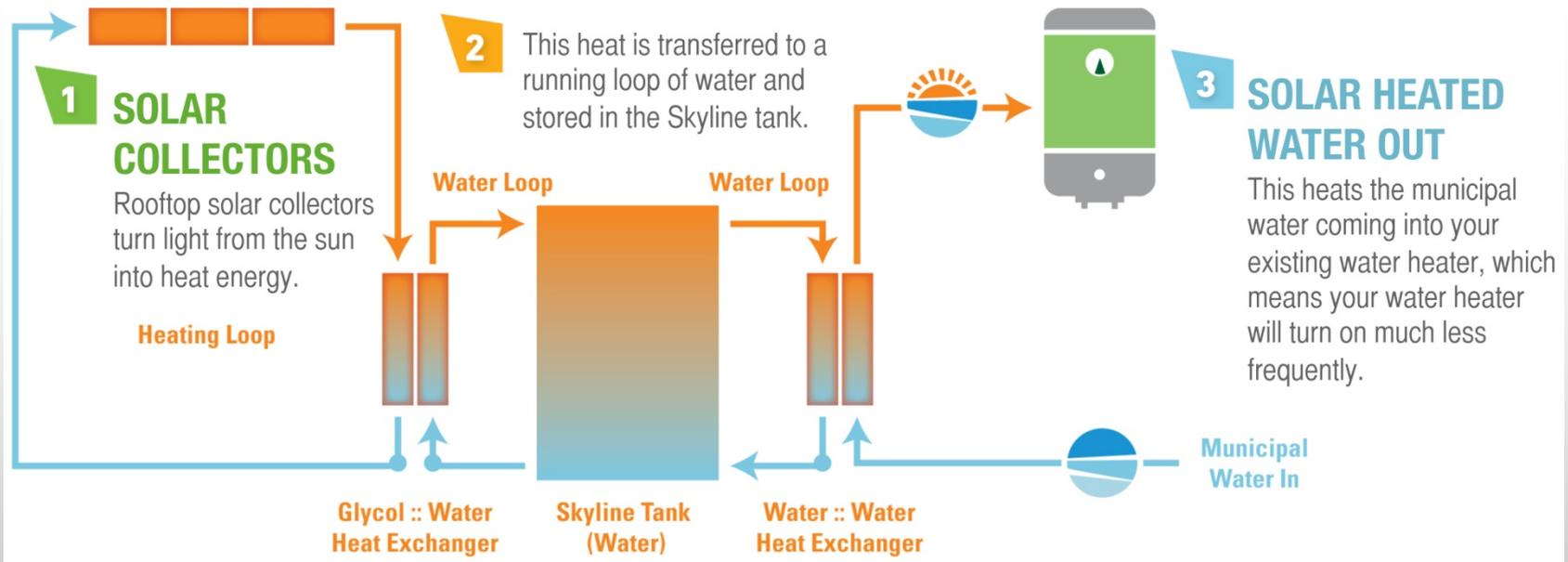
Installation Tailored to Roof Conditions



2640 Square Foot Solar Array

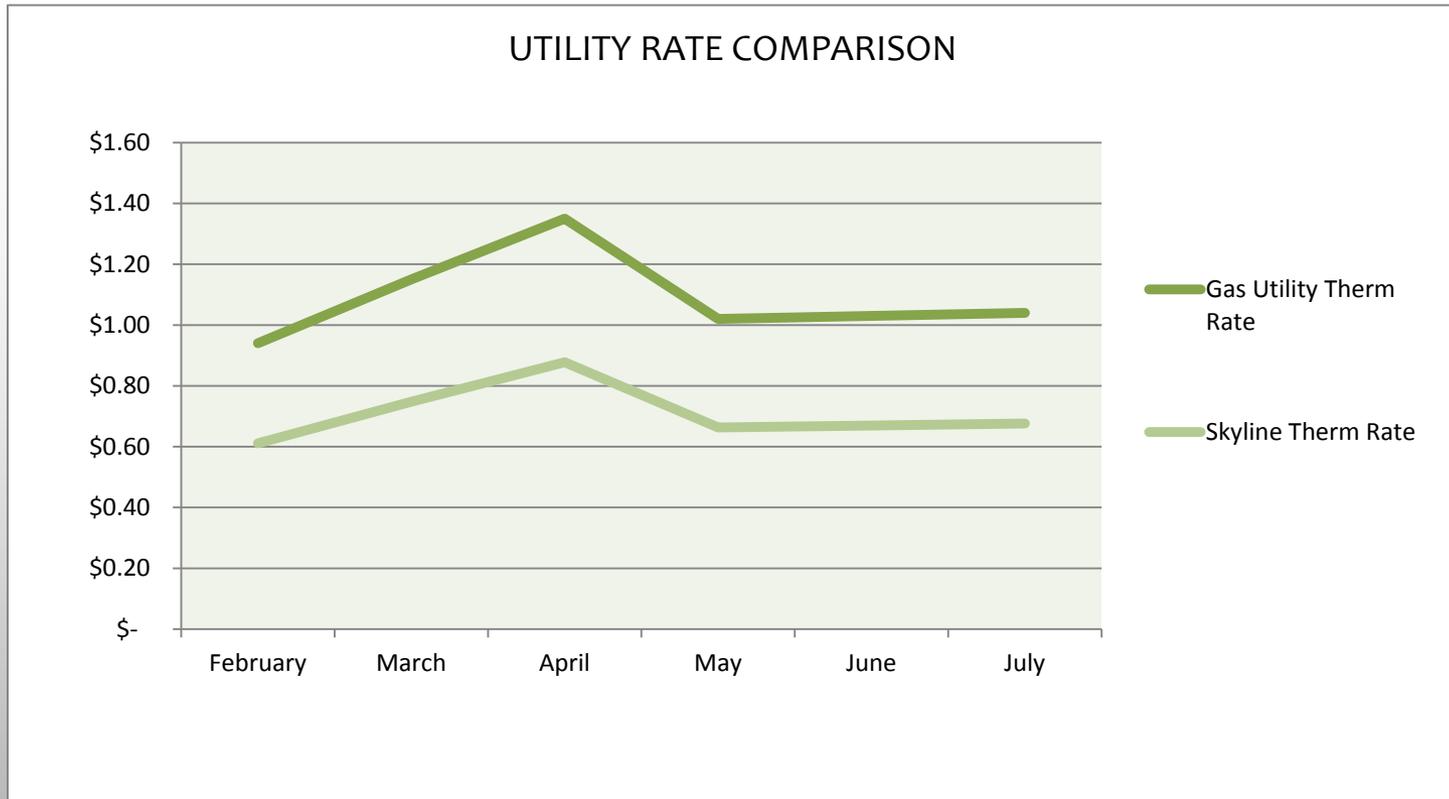


Solar System Information



- Solar water heating system pre-heats incoming municipal water before reaching boiler
- Solar offsets natural gas use for domestic hot water
- \$320,000 system value: 64 Apricus (evacuated tube) collectors and 3,000 gallons of solar hot water storage
- One of the largest solar hot water systems in DC

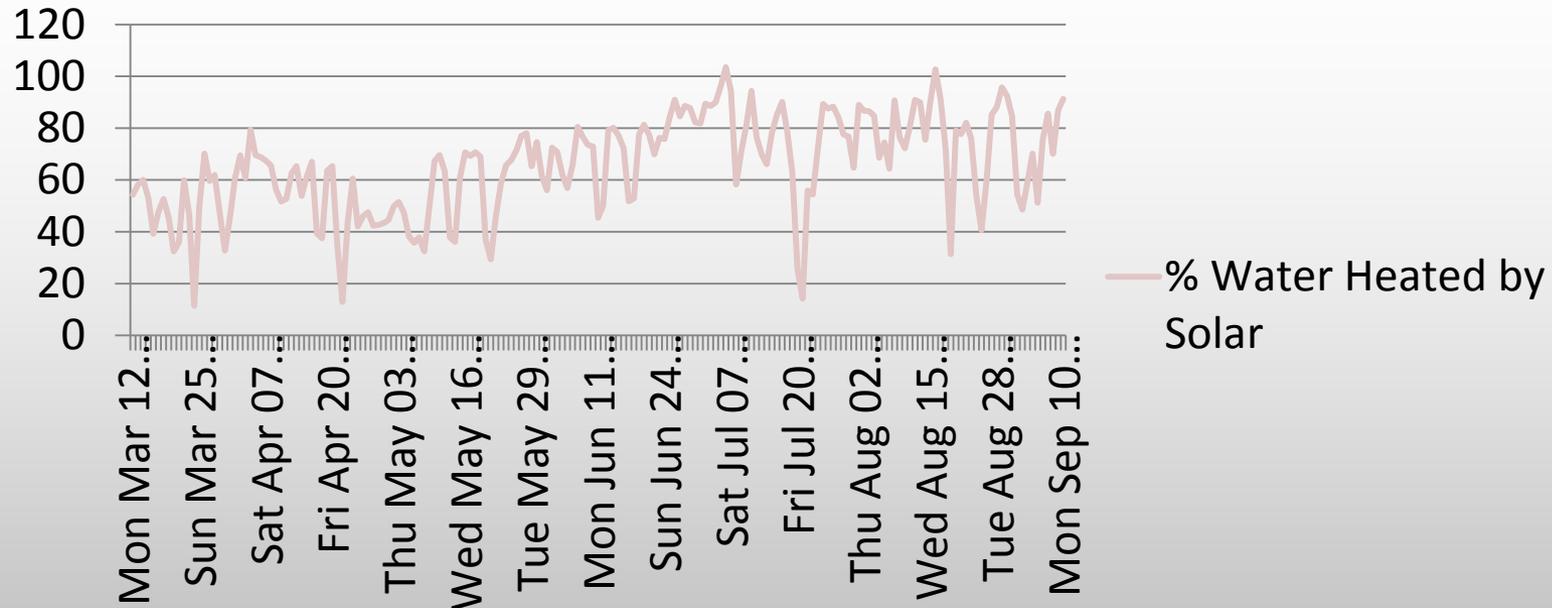
Solar Pricing



Skyline Innovations solar price for hot water indexed at a fixed 35% discount to the fluctuating utility rate

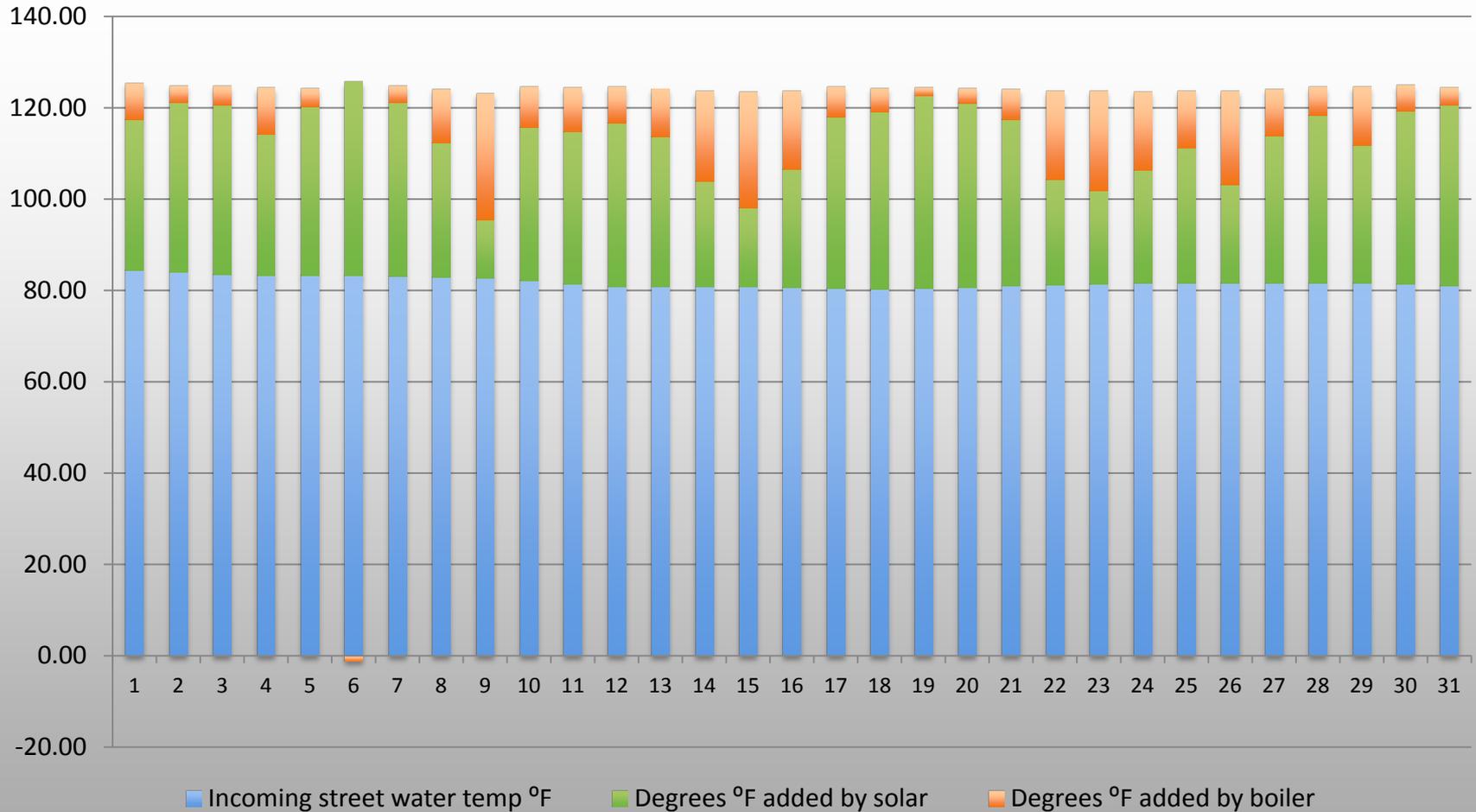
System Performance: Solar Fraction

% Water Heated by Solar

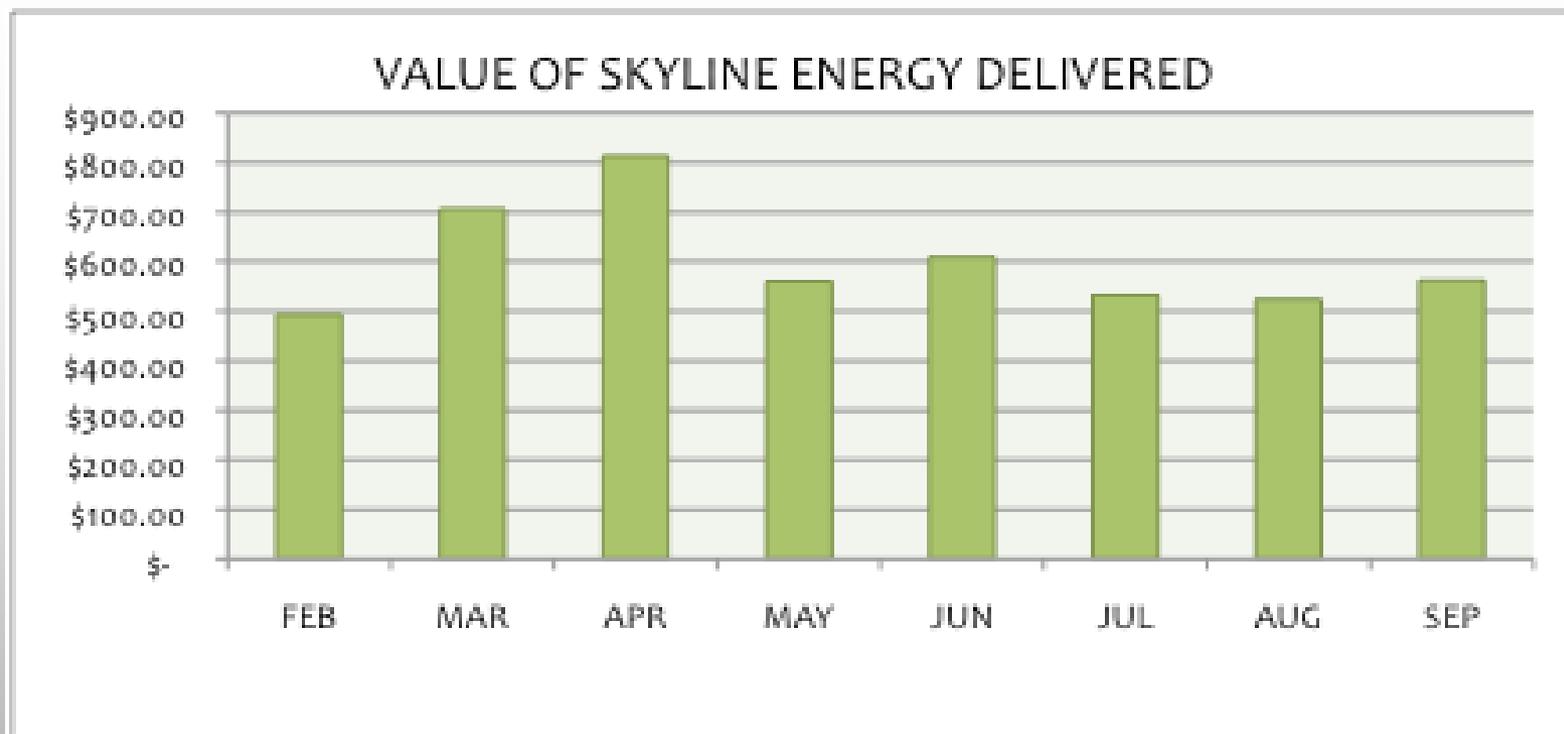


- In summer months, solar hot water provides nearly 100% of water heating needs
- Properly sized system and storage tank is critical for solar fraction due to fluctuating incoming water temperatures (Potomac River)

System Pre-Heats Municipal Water



System Performance: Savings



- The chart above shows the amount that 4600 Connecticut Ave *would have paid* the gas utility provider without solar
- 4600 Connecticut Ave Savings to Date: \$1,243.34

Conclusions

- Solar water heating is ideal for multifamily domestic hot water utility bill savings
- Optimized system sizing important to maximize system value
- Complex decision-making processes simplified through low-risk, turnkey financing solutions
- Reducing the demand on boilers during non-heating seasons will extend equipment life and reduce maintenance costs

Thank You



Speaker

Arlington Partnership for Affordable Housing (APAHA)



Nina Janopaul

President / CEO

njanopaul@apah.org

Background

- CEO, APAHA (2007 – Present)
- BA, Harvard University

Leadership Positions

- Community Energy Advisory Group
- Virginia Housing Development Authority (VHDA) Advisory Committee
- President, Housing Association of Nonprofit Developers (HAND)

Awards

- Developer of the Year, HAND (2011)
- Non-Profit Business of the Year, Arlington Chamber of Commerce (2008)



EPA Webinar: Solar Water Heating for Multifamily Affordable Housing



Nina Janopaul, President/CEO
Arlington Partnership for Affordable Housing
njanopaul@apah.org



- Award-winning non-profit founded in 1989
- Mission: To own, develop and preserve quality affordable homes that enhance the Arlington community
- Owns 995 rental homes at 12 properties
- 170 households receive rental subsidy and/or supportive services
- Properties funded with Low Income Housing Tax Credits, HOME loans and County gap financing
- Only affordable housing developer committed exclusively to the Arlington community





COLUMBIA GROVE

Year Built: 1954

APAH purchased: 2003

Neighborhood: Columbia Forest

Most Recent Renovation: 2009

of Units: 208

of Affordable Units: 130

Unit Sizes: 1 and 2 bedroom

First EarthCraft Virginia certified multi-family renovation in Northern Virginia. Rehabbed with Low Income Housing Tax Credits in 2008. Owner-provided hot water system.



- Solar Water Heating System offsets use of natural gas for domestic water heating
- Skyline Innovations provided and managed financing, engineering, installation, monitoring and 10-year O&M at no expense to APAH
- Project enabled by supplemental funds from the Virginia Solar and Wind Power Rebate Program (ARRA)
- Supports Arlington's new Energy Plan



Due Diligence Process

- **LEGAL:** Negotiate Skyline contract terms and conditions
- **ACCOUNTING:** Verify no conflict with Low Income Housing Tax Credit partnership structure
- **LENDER/INVESTOR:** Approvals
- **MECHANICAL/STRUCTURAL:** Review proposed system
- **ROOF WARRANTY:** Confirm warranty is not violated

- **TOTAL COST:** 30 – 40 hours staff time and \$8,000



SOLAR COLLECTORS



MONITORING SYSTEM



STORAGE TANKS



PUMPS, CONTROLLERS, HEAT EXCHANGERS



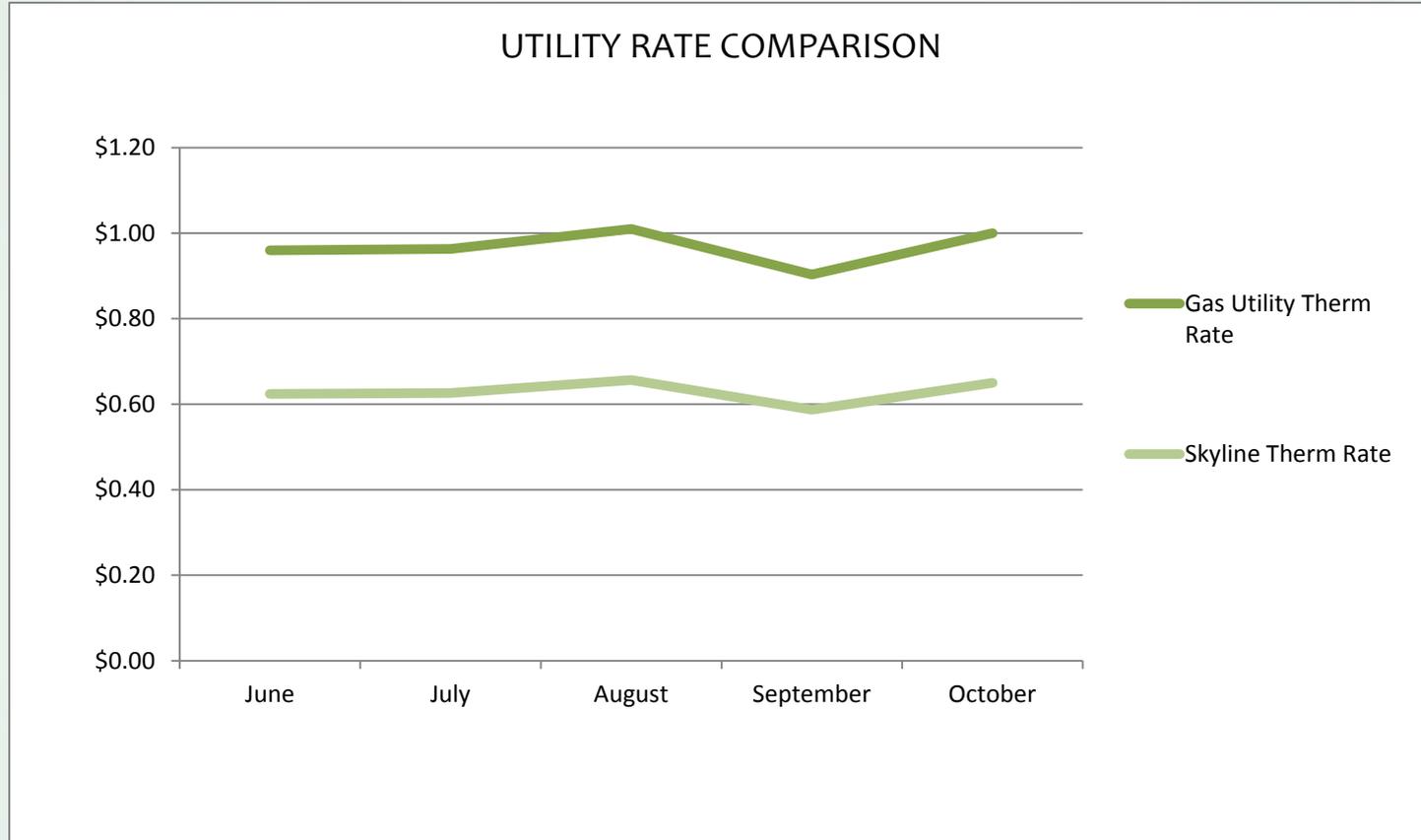


SOLAR WATER HEATING SYSTEM INFORMATION

Arlington Partnership for Affordable Housing

- 3 solar water heating systems at each garden-style building (of 19 buildings total)
- Total systems value: \$230,000
- 19 Solene Aurora (flat plate) solar thermal collectors
- 800 gallons solar hot water storage
- Systems completed June 2012

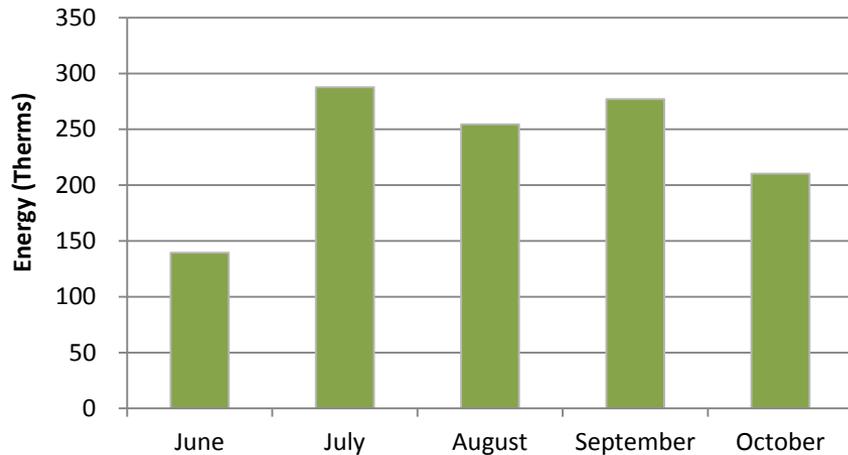




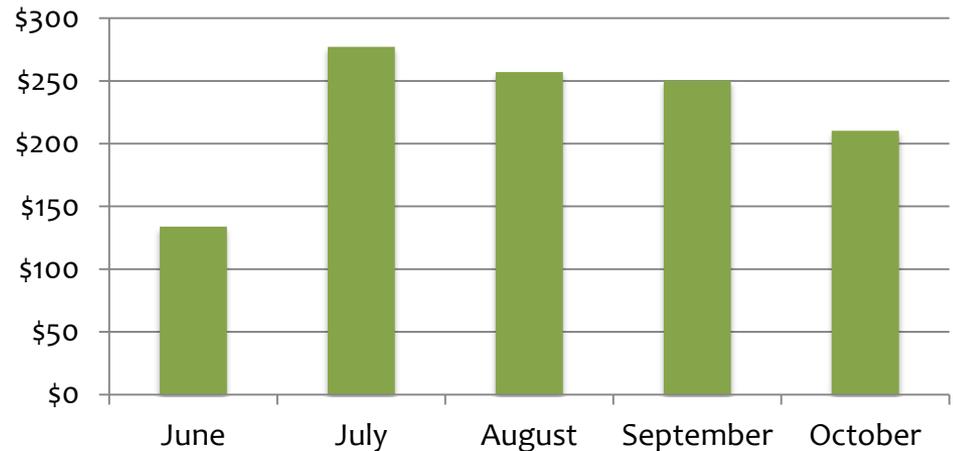
Solar energy priced at a fixed 50% discount to the utility rate



SKYLINE ENERGY DELIVERED



VALUE OF SKYLINE ENERGY DELIVERED



- The total solar energy (therms) used for DHW across the 3 buildings, displacing natural gas consumption (1,169 therms total)
- Total savings June – Oct. 2012: \$774
- Savings Split 50/50 with APAH



- Be prepared to act quickly on one-time or emerging state renewable energy incentive programs
- Solar water heating power purchase solutions enable non-profits to receive pass-through benefits of tax-based federal solar incentives
- Look for scale opportunities to justify due diligence costs to owner
- Contract structured to allow APAH to acquire system at Year 10 and benefit from 100% of savings for remaining useful life of the system



Our Vision

A diverse and inclusive, transit-oriented, sustainable community that welcomes and values all residents.

Our Role

Marry best practices in affordable housing finance and development with a deep commitment to the local community to advocate, preserve and build affordable housing.

Nina Janopaul, President/CEO, njanopaul@apah.org

Solar Water Heating in Multi-family & Affordable Housing Buildings: Lessons from the field

Question and Answer Session

Please type your questions into the Q/A window on your screen.

For a copy of the slides or additional questions, please contact:
James Critchfield, Director, Clean Technology Initiatives
(Critchfield.James@epa.gov)