Better Buildings By Design 2013
Building the **Renewable Energy Ready Home**
Solar Thermal Lessons Learned and Results

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Doug Merrill

• 20 + years of manufacturing experience
  – General Electric
  – Husky Injection Molding
  – Consulting, Teaching

• 5 Years of Solar Hot Water experience
  – Consulting (supply chain)
  – Monitoring development
  – Principal in Sunward Systems
Solar Hot Water System Advantages

• Reduces need for electricity or fossil fuel

• Saves money

• Easy to integrate
Comparison of Energy Standards

DHW Heating is Typically Second Highest Building Load
Why Solar Hot Water?

• Saves money...a good investment
  – ROI is good for most any fuel
    • Propane 9%
    • Oil 7%
    • Electricity 7%
    • Gas 3%
  – Few alternatives in New England
    • Heat pump & geothermal economics not great
    • Wood is good, but labor intensive in the summer
Solar Hot Water Siting

• Building Compromises: Collector orientation
  – Collectors facing true South are ideal
    • Fall-off in production is gradual...up to 45° from South OK
    • Makes ‘tracking’ unnecessary
  – Collector ‘tilt’ is also a gradual falloff...nominal is angle=latitude
    • Steeper is better (up to 5-10 degrees)
    • Helps boost production in winter
    • Assists in snow shedding
  – Shading
    • Partial shading OK- do analysis!
    • Small feature shading (sticks, power lines) not a factor
    • Want at least 5-6 hours of direct sunlight a day
    • For new home sites...consider the landscaping choices and how they will look in 10 years
Roof Design Considerations

- Orientation & pitch determine if roof is viable
- 50-80 square feet of space
- Check ‘border’ around collectors for fire access
- No penetrations or features within space
- Design for 6 lbs/ft\(^2\) more than code
- Access to attic makes installation easier
- Slate & ceramic roofs are a challenge!
Integrating a SHW System

• Ground mount options
  – Usually lower, so watch for shading
  – Tubing & wiring run in trenches
  – Easier to service & clear snow
  – Typically more flexible, slightly more expensive
Integrating a SHW System

- Integration with backup DHW system
  - SHW acts as a ‘pre-heater’
  - Not cost-effective to produce 100% solar in New England
- Fuel agnostic...works with gas, oil, electricity
- Functions most effectively with storage type heater
- Indirect fired systems are much less efficient than their ratings (due to summer cycling)
Mechanical Integration

• Integrated tank/heater/heat exchangers available, but force many compromises
  – Lower efficiency (less storage, mixing)
  – Higher lifetime costs
  – Less space required

• Review total rise of system versus pump spec’s

• Mixing valve is necessary
  – Preferably on the output of the backup system
  – This is consistent with current building codes in most places
Minimize DHW Load!

- Insulate hot water piping throughout the home
- Minimize hot water piping run length
- Install low flow shower heads and aerators
Water & Space Heating Readiness

• Much larger collector footprint required  
  – (roughly 10% of heated area)
• Radiant heating with high thermal mass ideal 
• Maximize passive heating to minimize solar collection system needs 
• Must address summer heat over-production  
  – Mechanically 
  – Physically 
  – Heat Dump
Benefits of building Solar-Ready

- Cost to contractor/homeowner minimal ~$150
- Some design compromises may be required
- System effectiveness far higher
- Installation cost savings about $600
- Builder can finish home before customer makes final installation decision
Lessons Learned: Performance Data

- 500+ Systems sold
- A dozen monitored
- Two case studies...
  - Low use passive home
  - High use passive home
Lessons Learned – Case Study

• Home occupied 2011
• Typically 2 residents
• Low hot water usage
  – 38 gallons per day
Passive House Solar Hot Water Data

Solar Hot Water Production 2012 - Low Load Home

- DHW BTU
- SHW BTU
- % from Solar

October Output Well Under Expectation
Passive House Solar Hot Water

• Low Load Home Conclusions
  – 70% of the 2012 DHW energy needs have come from solar

• What about a home with a higher DHW Load?
Passive Home SHW Study #2

- 250’ South of home #1
- SHW system installed in July 2012
- Monitoring installed in August 2012
  - Data is fresh!
- 3-5 Residents
- Very high DHW use
  - 100 Gallons/Day
Passive Home SHW Study #2

Daily DHW Energy Usage Sept 2012

- 81% of DHW energy from solar
  - (Compares with 86% on low use home)
- 2X Energy produced (45KBTU per day!)
Passive Home SHW Study #2

Electric Cost

- Savings of $40 - $70 per month
Questions ?