



Measured Performance of Side-by-side, South Texas Homes

Thermal Performance of Exterior Envelopes
of Whole Buildings XI
December 9, 2010

by

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Side-by-side Homes



- 1,979 sq.ft.
- Completed March 2009
- Facing WSW

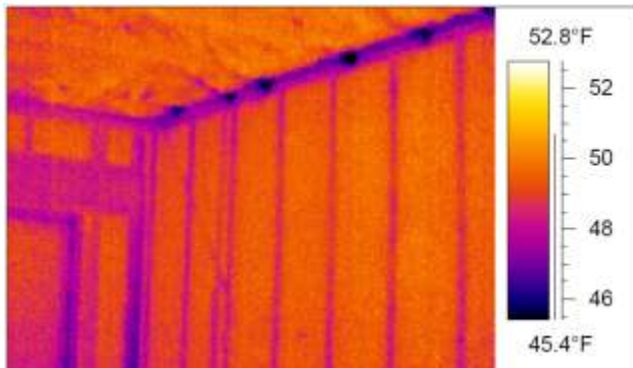


HERS Indices

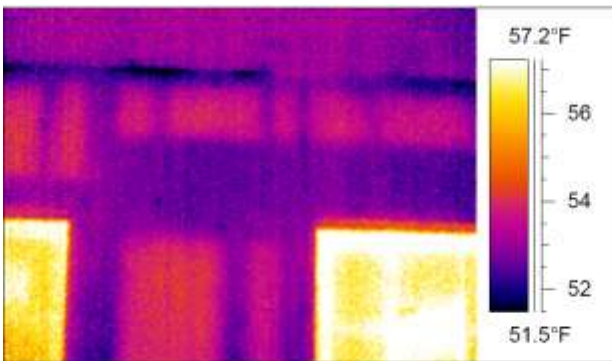
- CP1 – 86
- CP2 – 54
- CP3 – 37
with 2.4kW PV



Envelope Improvements



CP2



CP3



- Roof line extension for Shading
- Sealed Attic
 - R-28 Spray Foam @ Roof Deck
- Frame walls
 - R-15 + R-3 Sheathing
- Windows
 - U-value 0.34 vs 0.53
- Enhanced Air Sealing
 - ACH50 = 1.95 for CP3
 - ACH50 = 3.64 for CP2
 - ACH50 = 5.84 for CP1
- 100% Fluorescent Lighting



HVAC Improvements



- 18 SEER A/C with 2-stage compressor (vs SEER 14)
- 94 AFUE furnace or 9.5 HSPF heat pump (vs 80 AFUE)
- Variable speed Fan Coil
- Manual S for coil matching for latent load
- Programmable thermostat controls T & RH
- Run-time fresh air intake
- Duct design minimizes delta P losses





Combustion Safety Measures



- CO Monitors near combustion equipment
- External Vents for cooktop & dryer
- Sealed combustion furnace & water heater
- Air equalization jumper ducts





Measured Electric Load on Hottest Summer Day July 8, 2009

Demand management program period
 May – September
 3 to 7pm CDT

Air Conditioning Peak Reduction

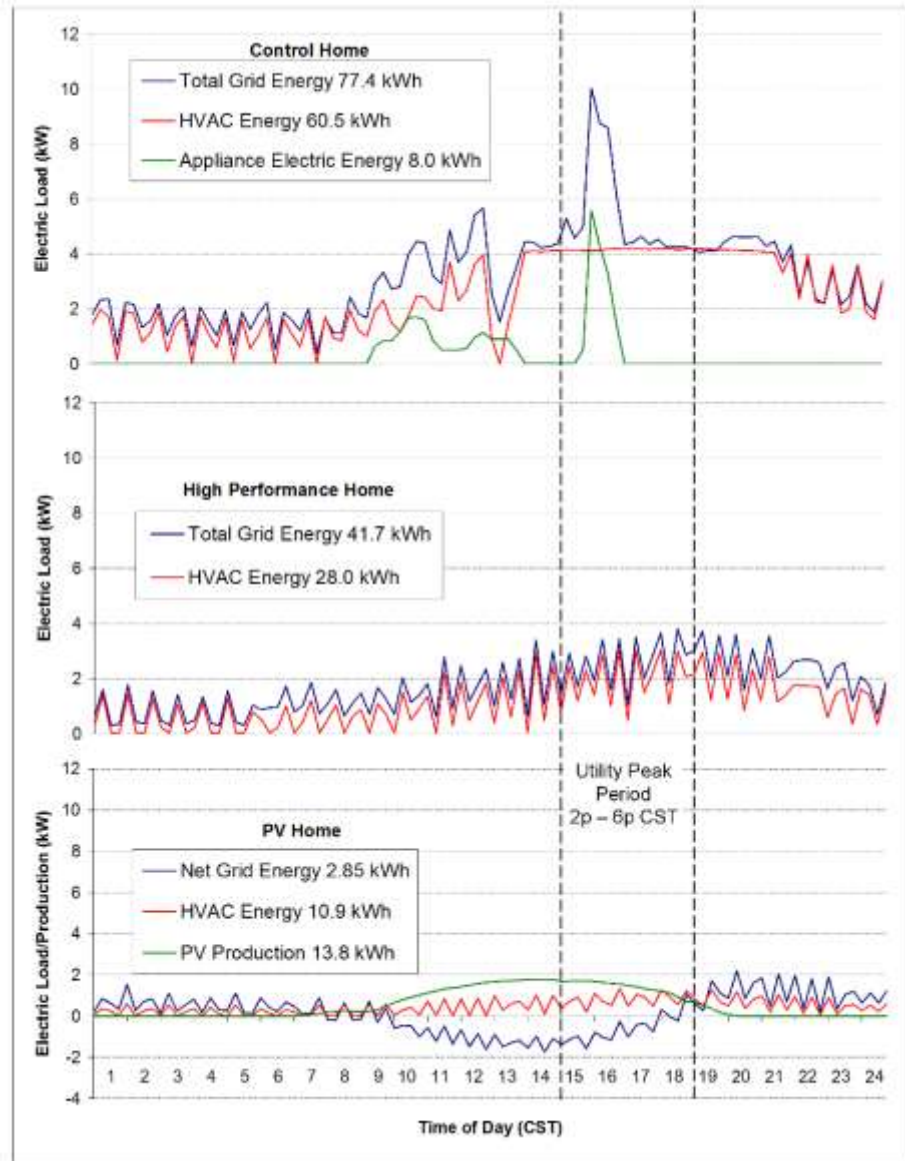
Hi-Performance: 1.17 kW, 28%

PV Home: 2.88 kW, 68%

Overall Peak Reduction

Hi-Performance: 6 kW

PV Home: 8 kW





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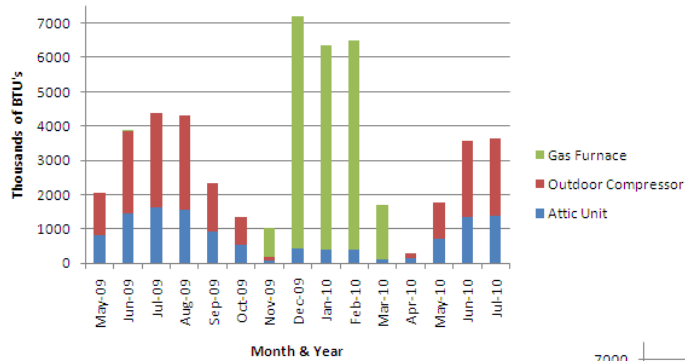
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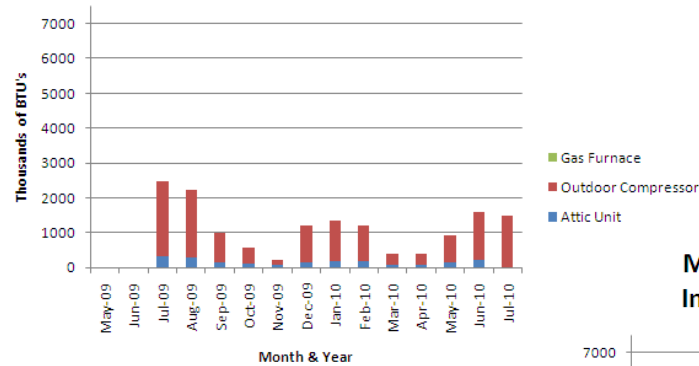
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HVAC Comparisons

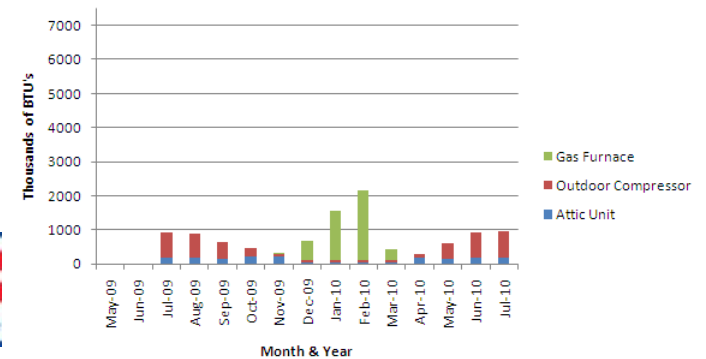
Monthly Cooling & Heating Energy Control Home



Monthly Cooling & Heating Energy Improved Heat Pump Home

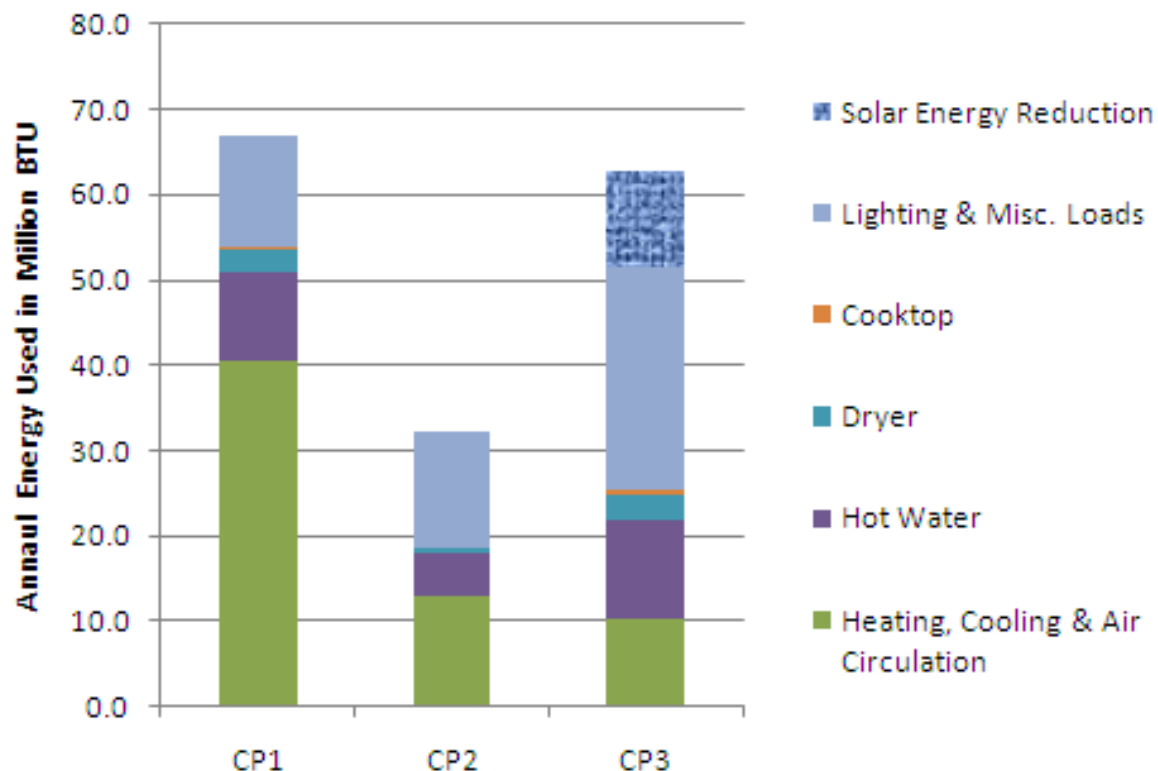


Monthly Cooling & Heating Energy Improved Home-100% Spray Foam



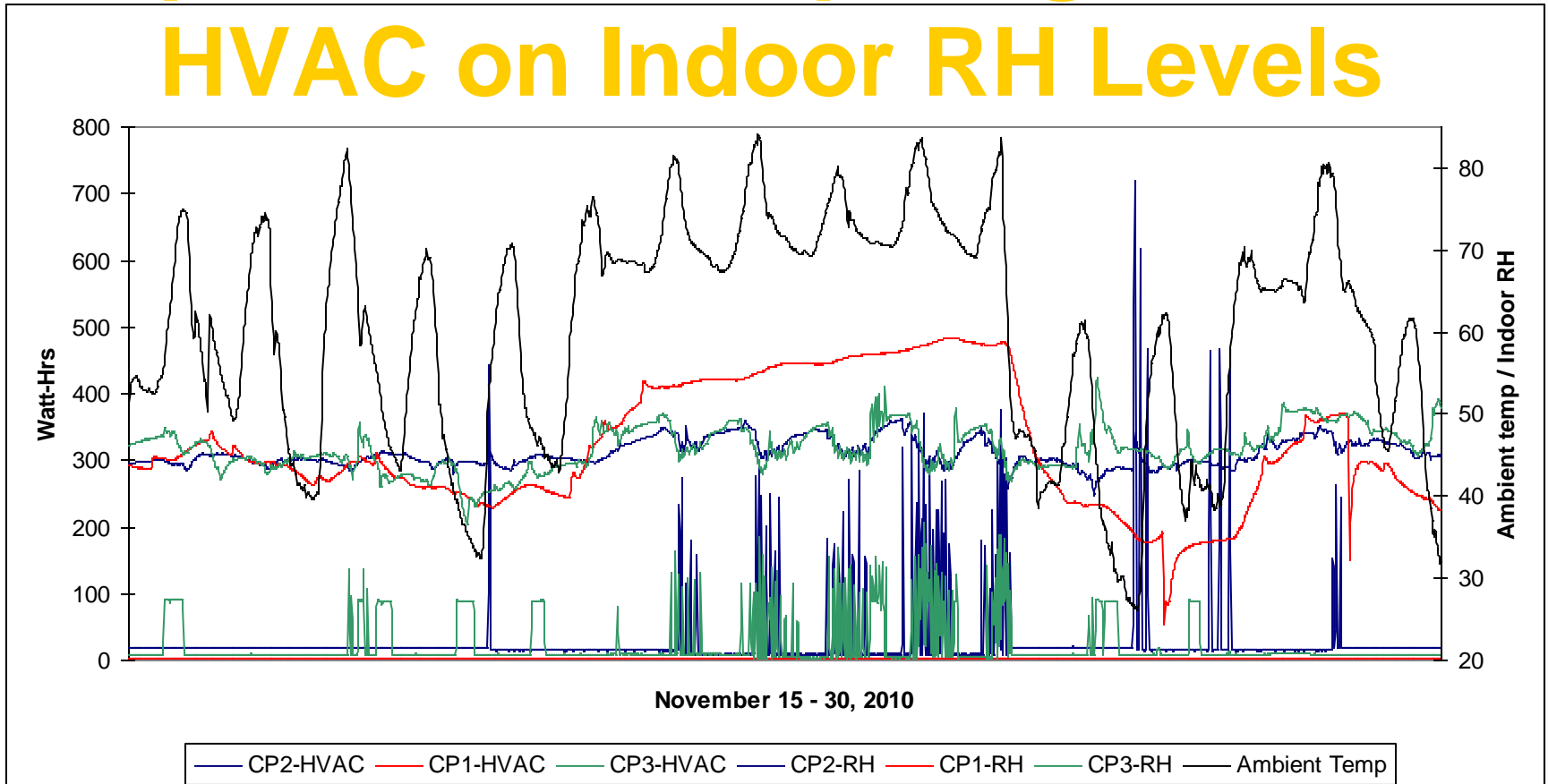


1st Year Results





Impact of Envelope Tightness & HVAC on Indoor RH Levels

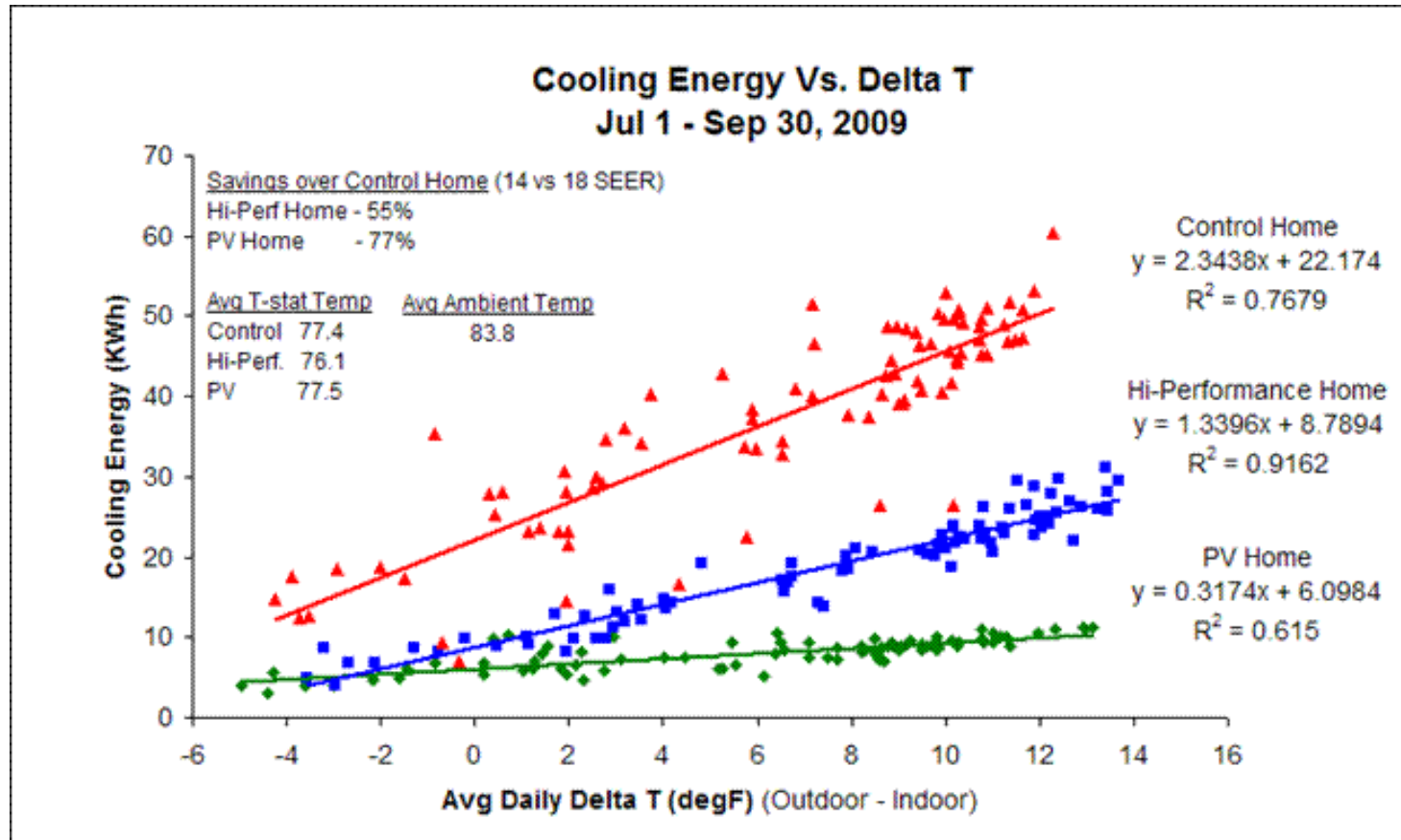




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4 Days removed from 92 day data set due to:

- Low temperatures
- Data collection errors





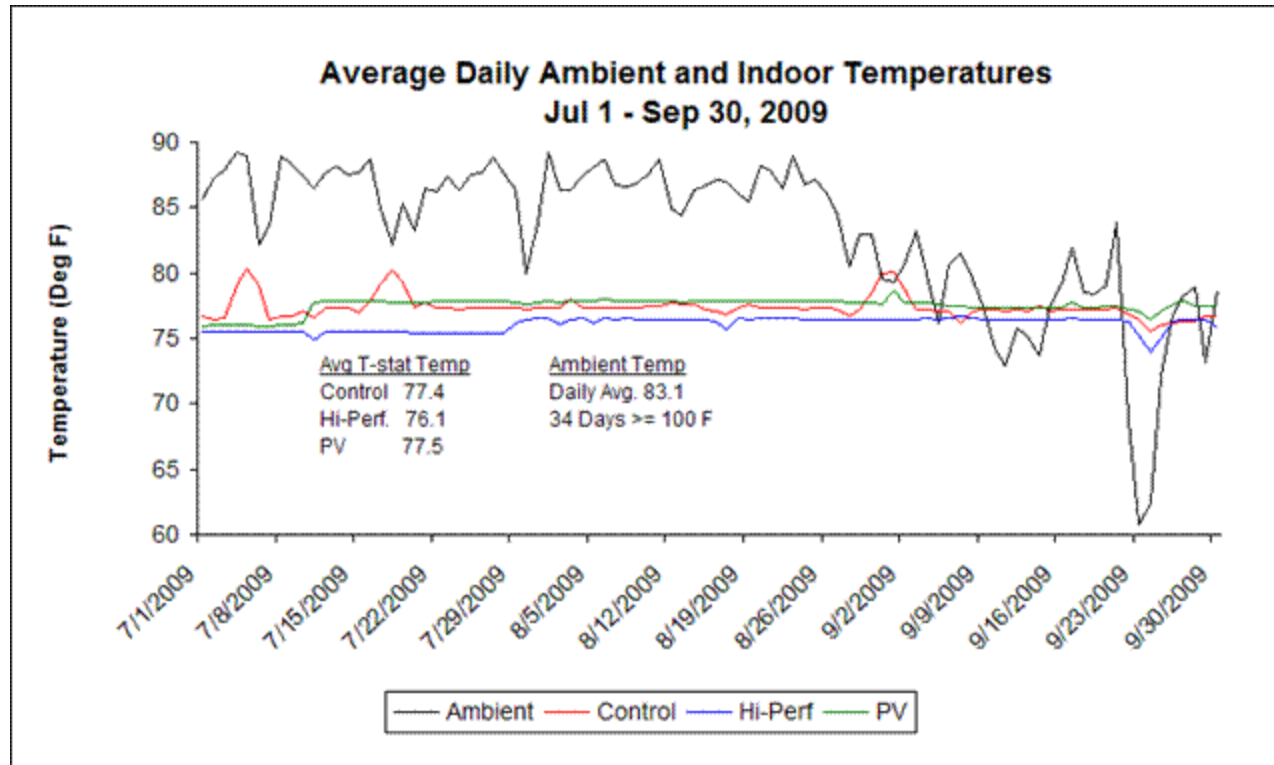
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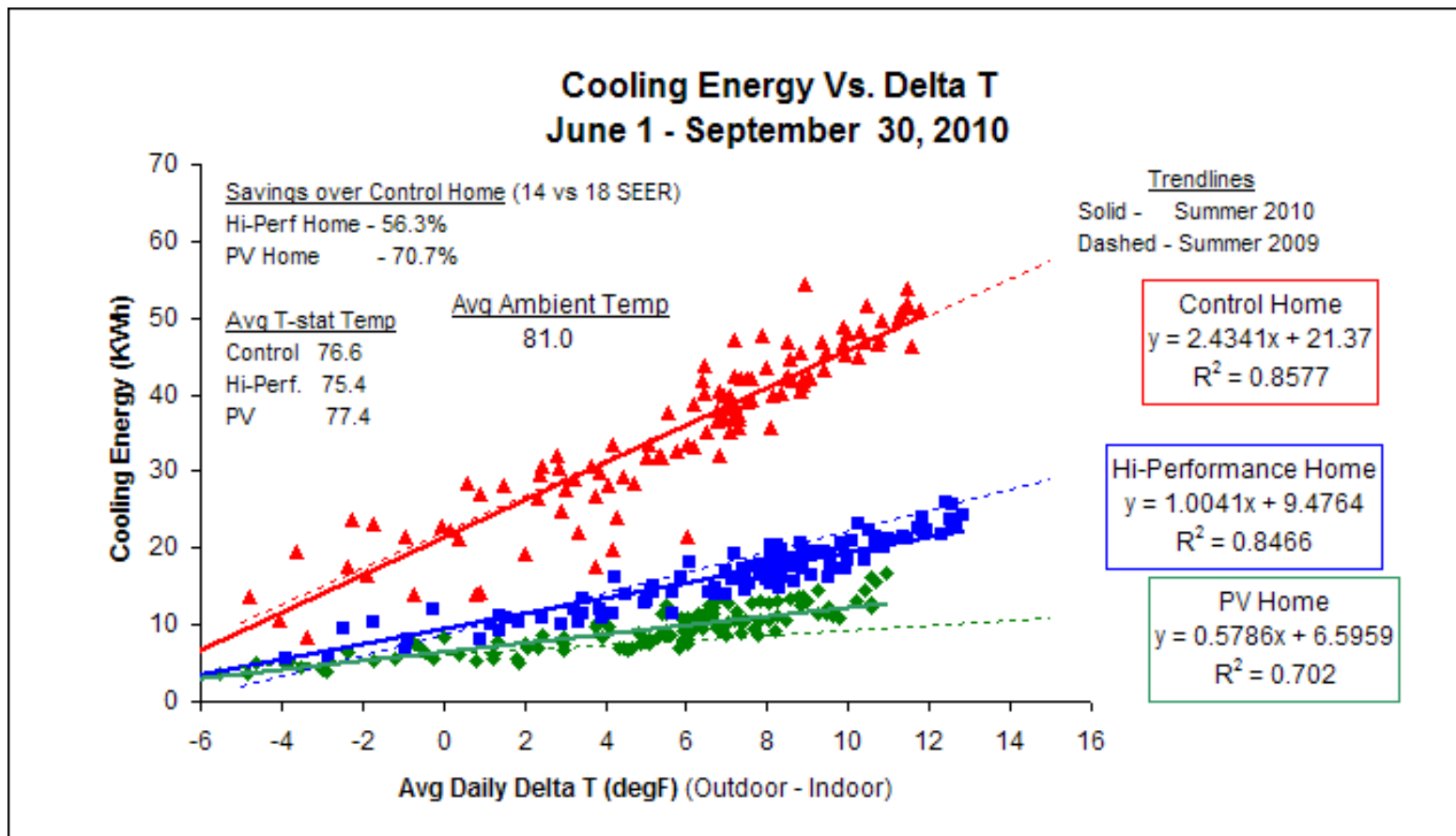
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- PV home unoccupied during July and August
- Programmable T-stats not used
- Several unoccupied periods in Control home



5 Days removed from 122 day data set due to datalogger failure



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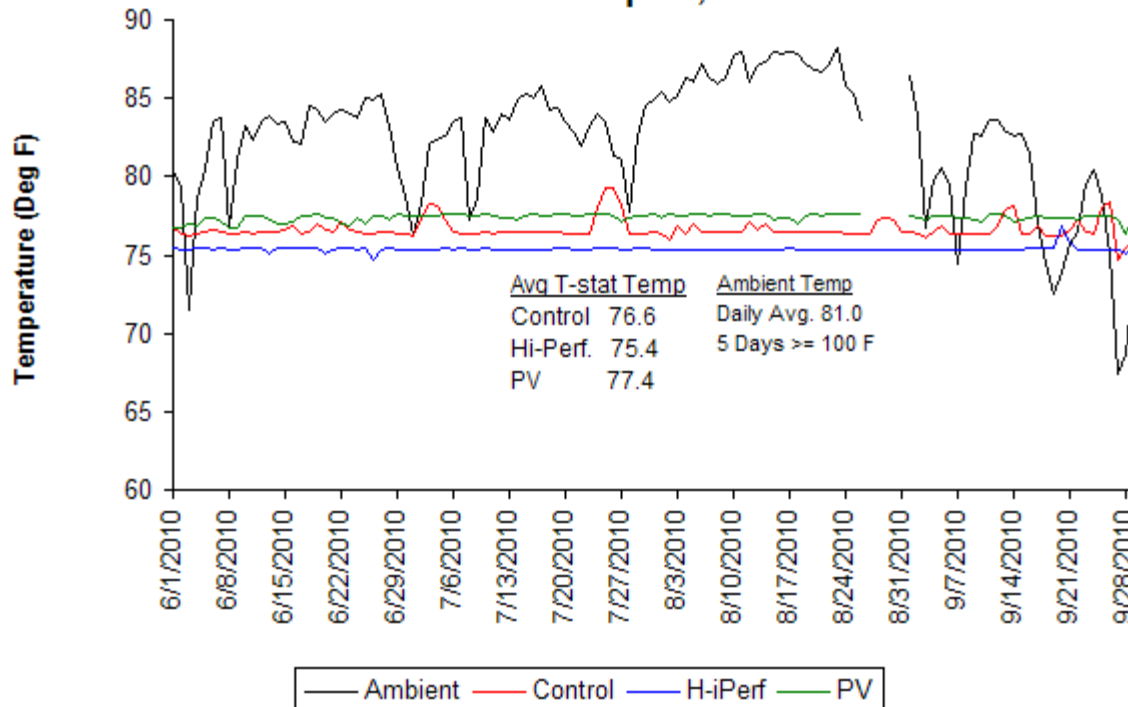
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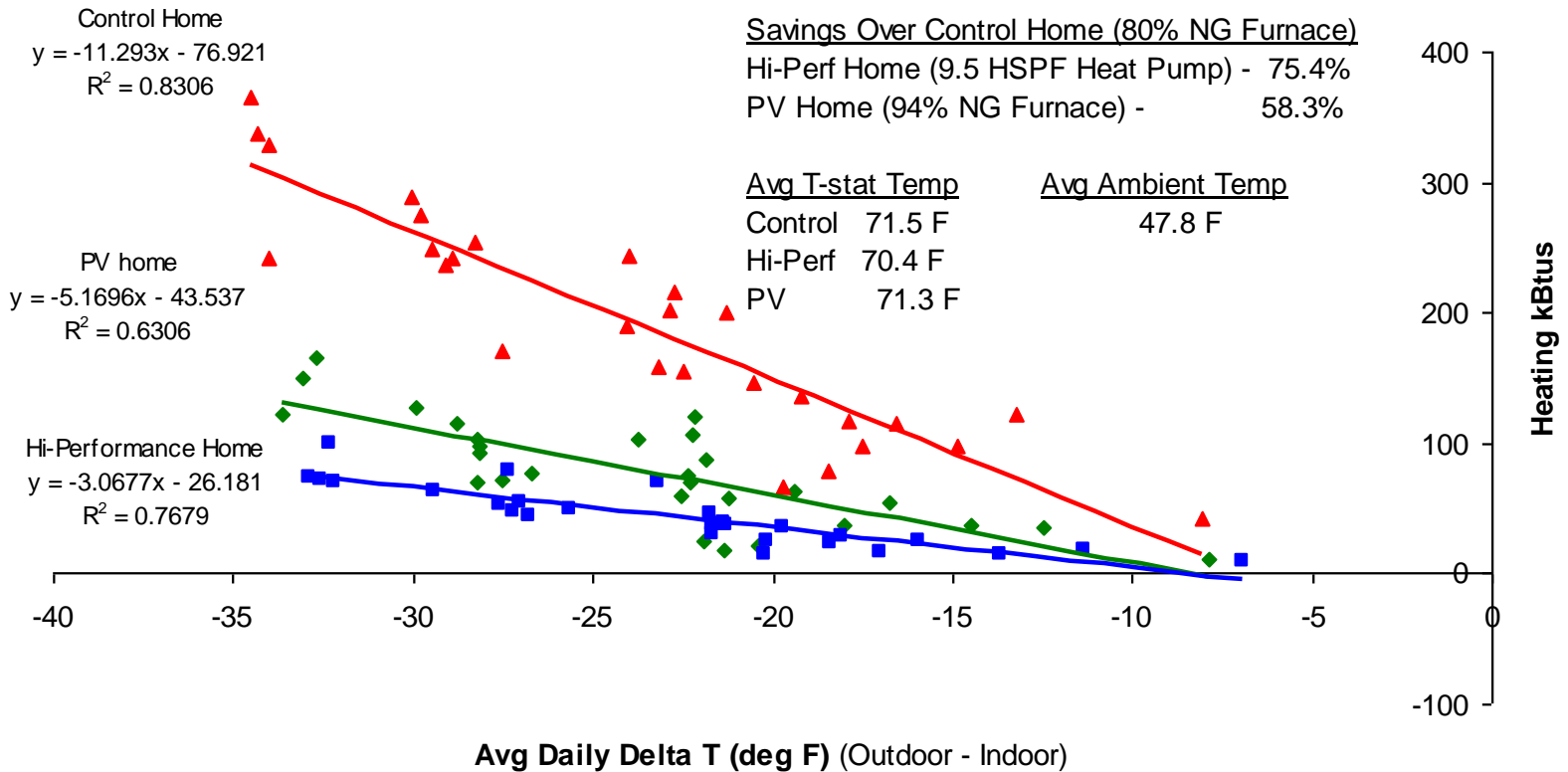
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Average Daily Ambient and Indoor Temperatures
Jun 1 - Sep 30, 2010





Heating kBtus Vs. Delta T February, 2010





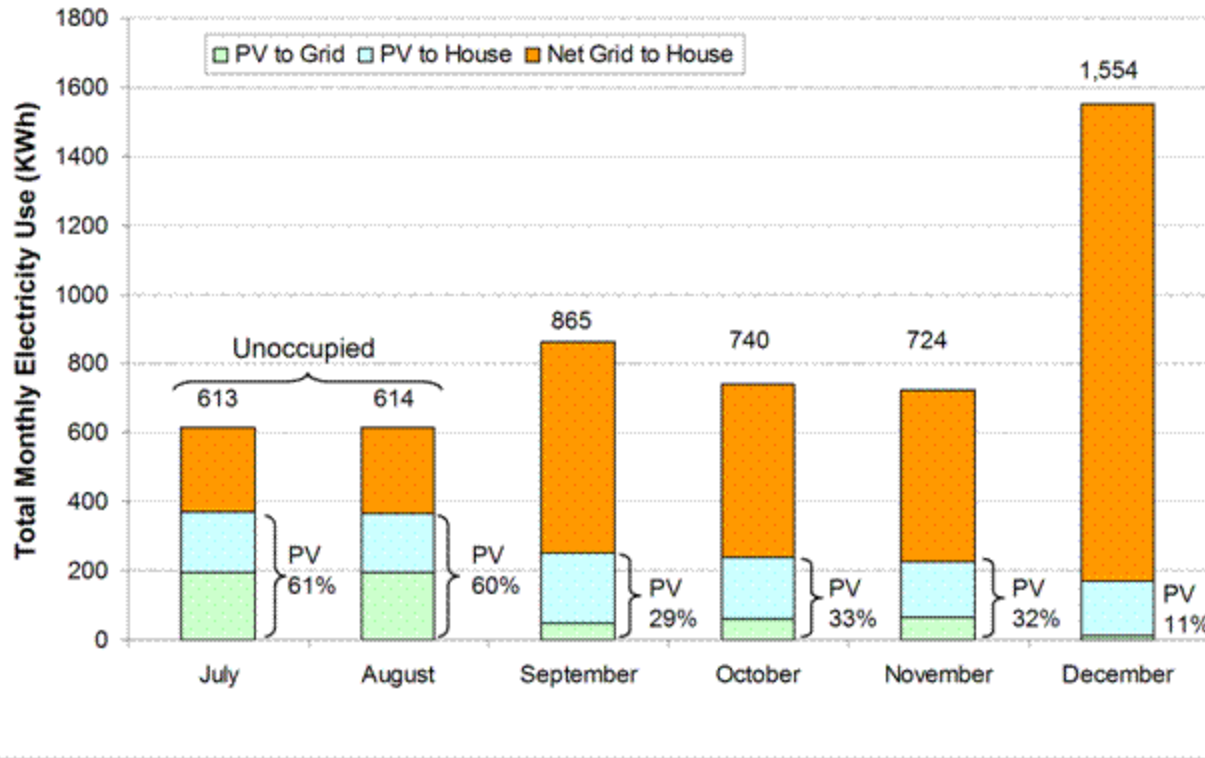
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**2009 PV Home Monthly Electricity Use
 and Percentage Offset by PV**





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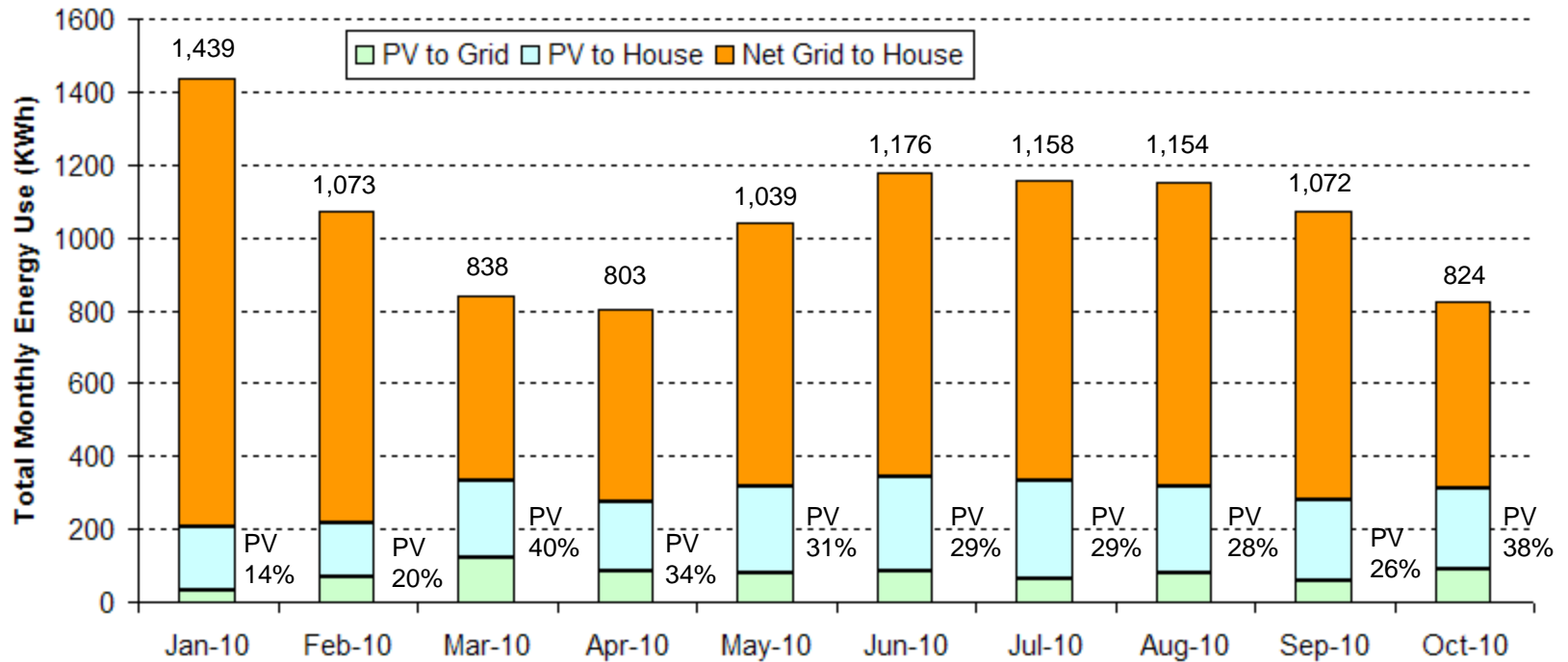
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**PV Home Monthly Energy Use
 and Percentage Offset by PV**





Conclusions

- 6 to 8 kW (62 to 83%) demand reductions over control home on hottest day during utility peak period
- Peak air conditioning loads reduced 1.2 to 2.9 kW (28 to 68%) during same period.
- 55 to 77% cooling energy savings in improved homes
- 2.4kW grid-tied photovoltaic array provided 25-30% of total electric energy needs during most months & offset 100 % of annual HVAC energy consumption



Acknowledgements

- Lake Flato Architects, Inc.
 - preconstruction modeling and development of construction specifications
- Woodside Homes of South Texas
 - ensured adoption of modified building techniques
- Builder's Energy Rater
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