Philip Kerrigan Jr., PE
Building Science Corporation

New Construction Pilot Community Evaluation – New Orleans, LA

Building America Residential Energy Efficiency Technical Update Meeting

U.S. Department of Energy | Energy Efficiency & Renewable Energy

Building America – U.S. Department of Energy

Building Science Corporation

Building America Community

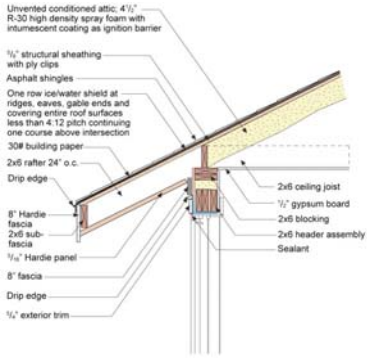
PROJECT HOME AGAIN

Project Home Again

- Project Overview
  - Location: New Orleans, LA (2A)
  - Type: Single Detached Site Built
  - Plans: 1-2 story, 2-3 bedrooms, 2 baths
  - Utilities: All electric
  - Floor Area: 1016 - 1551 sq. ft.
  - HERS Index: 64 - 69
  - B10 Source Energy Savings: 23-27%
  - # Homes in Study: 19

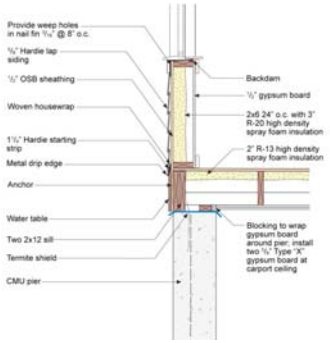
House Design

- Enclosure Design
  - Phase I Roof –
    R- 30 Roof
    (4.5" CC HDSF UV cath. attic)
  - Phase II Roof –
    R- 21 Roof
    (3.5" CC HDSF UV cath. attic)



House Design

- Enclosure Design
  - R- 13 Floor
    (2" CC HDSF under subfloor)
  - R-20 Walls
    (3.5" CC HDSF 2x6 24" o.c. walls)
  - Windows
    Phase I: U = 0.36, SHGC = 0.30
    Phase II: U = 0.35, SHGC = 0.23



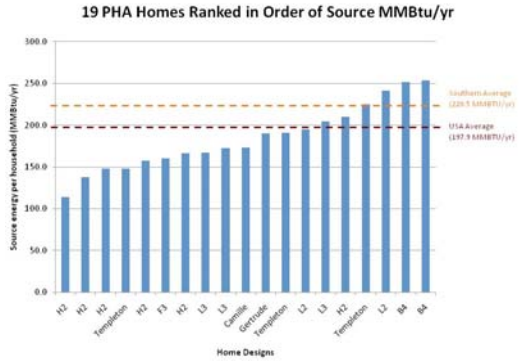
House Design

- Mechanical Design
  - Phase I and II:
    14 SEER/8.2 HSPF with whole house supplemental dehumidification
  - Rheem Electric Tank Water Heater EF=0.92
  - Full CFL package
  - Energy Star Appliances

Utility Bill Analysis

- BSC receives monthly electric bills directly from the utility company
- Have full year's worth of utility data for 19 homes Jan 2010 to Dec 2010
- All homes include supplemental dehumidification

Annual Actual Source Energy Use



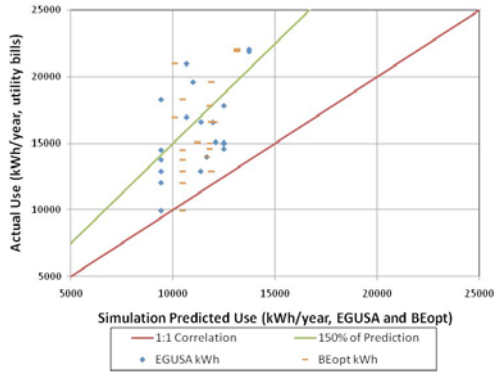
Predicted Models vs. Actual

- Energy Gauge USA and BEopt analysis are available for all addresses
- Neither program models supplemental dehumidification, therefore an estimated additional kWh was added to the B10 Benchmark calculations.

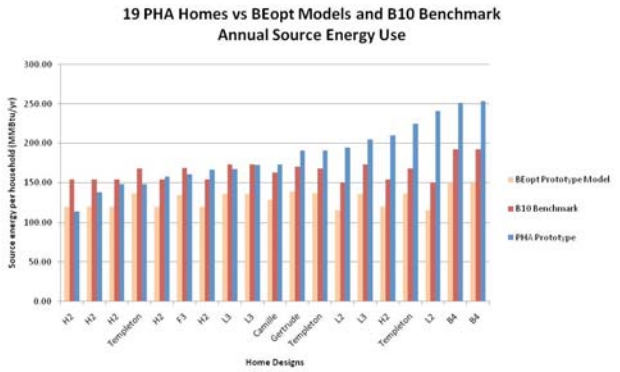
Dehumidification Calculation

Variable	Value	Notes
Estimate of run hours	876	Estimated 10% of 8760 hours per year
Electrical draw of unit (W)	830	from 115V, 8 Amps, 0.9 power factor. Energy used by fan compressor etc goes to space
Electrical draw of unit (Btu/hr). This is also equal to additional heat going into the space from the fan and compressor.	2,832	Multiply by 3.412
Heat of removed moistureadded to the space (Btu/hr)	3,000	AHAM (Association of Home Appliance Manufacturers) rated capacity (at 80 degrees F and 60% RH) is 90 lbs/day = 3.75 lbs/hr, derated by 20% because of lower temperature actual conditions = 3 lbs/hr. Multiply by 1000 Btus/lb of H2O to get the heat of space moisture removal.
Total heat going into the space when dehumid is running (Btu/hr)	5,832	Add the electric draw of the unit to the heat of moisture removed from the space
Amount of power used by cooling system to remove this heat (W)	278	1.5 ton 12 EER rated heat pump estimated EER = 21 during milder conditions when the dehumidifier is expected to be operating, from product catalog data. Divide Btu/hr by EER 21 to get Watts. EER is ratio of output cooling in Btu/hr over Watts of electrical use
Yearly energy used for this cooling (kWh)	243	Multiply by the estimated run hours
Additional energy used by compressor, fans (kW)	727	Multiply electrical draw of dehumidification unit by the estimated run hours
Total annual electrical energy used by the dehumidifier and the cooling system to remove the heat introduced into the space by the dehumidifier (kWh)	970	Add the yearly electrical draw of the dehumidification unit to the extra electricity used by the heat pump for cooling

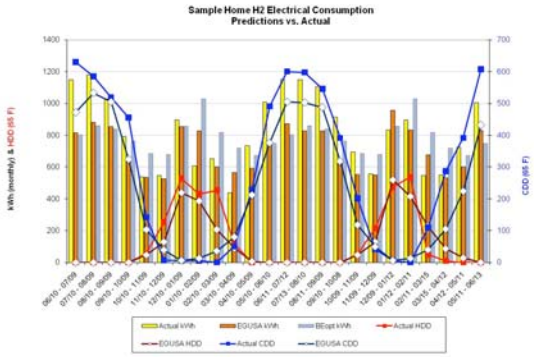
Scatter Plot – Predicted vs. Actual



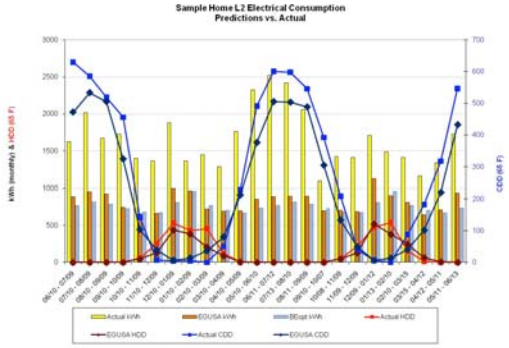
Actual vs. BEopt Predictions



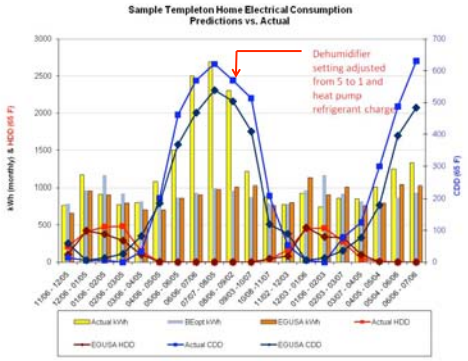
Example Monthly Data Graph



Example Monthly Data Graph



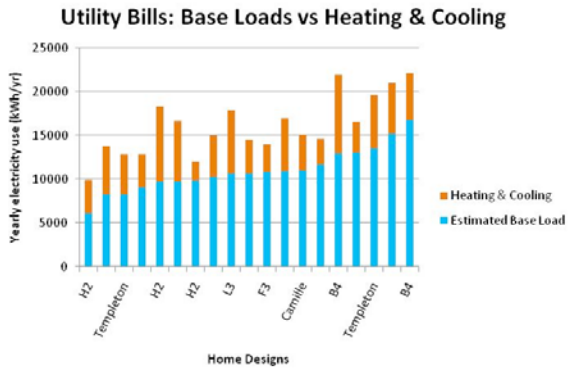
Example Monthly Data Graph



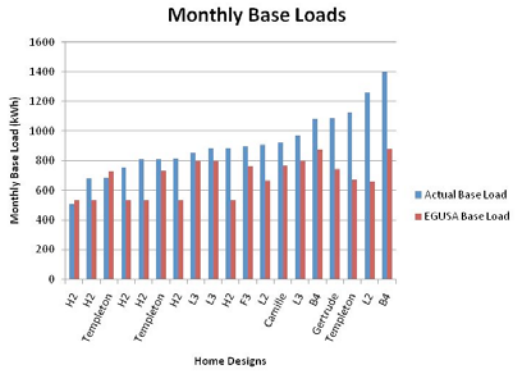
High Energy Use: Possible Causes

- High base loads
- Some homeowners are operating at lower cooling temperature set points
- Some dehumidifiers may be operating to maintain a very low %RH (~30%-40%)
- Occupancy rates may be different from model assumptions
- 27.4% more HDD during actual year
- 14.6% more CDD during actual year

Estimated Prototype Base Loads



Base Loads: Prototype vs. Models



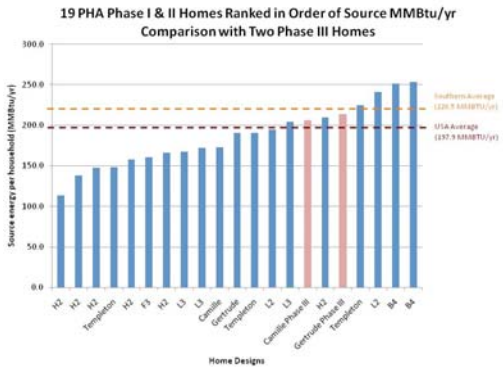
Houses with no Dehumidification

- Phases III and beyond lack supplemental dehumidification
- There is limited data available for Phase III homes
- Phase III has the same floor plans as Phase II
- Date range is different (Aug 2010 to July 2010)
- Only 2 addresses with a full year of utility data are currently available

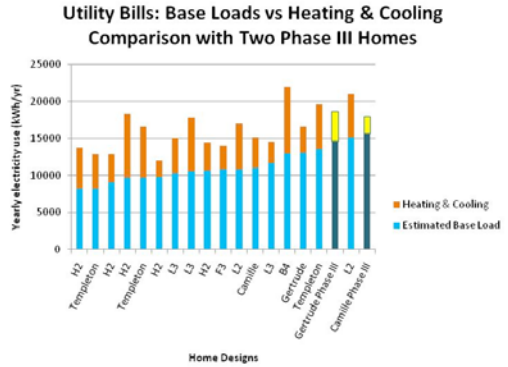
Phase III Design Changes

- Builder dropped supplemental dehumidification due to cost and initial installation issues
- Upgraded from 14 to 14.5 SEER
- Other specifications identical to Phase II

Annual Actual Source Energy Use



Estimated Prototype Base Loads



Discussion

- High baseline loads
- Actual weather was more severe than TMY3 file
- Lower cooling setpoint setting
- Higher occupancy rates
- Dehumidification is an unlikely culprit for excessive energy use in these homes
- Other installation issues (low or high refrigerant charges in heat pumps)

Possible Future Work

- Monitor interior conditions (temperature and % relative humidity)
- Monitor energy use of HVAC systems and dehumidifiers (kWh and run times)
- Monitor energy use of other end uses (hot water heaters, energy intensive circuits in homes)
- Perform a homeowner survey to gather data on occupant behavior
- Develop better homeowner education tools to promote energy efficient occupancy

Questions?

Philip Kerrigan Jr., PE
phil@buildingscience.com

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Building AMERICA U.S. Department of Energy

bsc Building Science Corporation

New Construction Pilot Evaluation 25