FLORIDA SOLAR ENERGY CENTER

Creating Energy Independence Since 1975

Air Distribution Systems in Conditioned Spaces – i.e. "Ducts in Unvented Attics"

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The Norm: Ducts in Unconditioned Spaces

- Losses and Risks?
  - IAQ Issues
  - Durability Losses
  - Conductive gains/losses
  - Duct Leakage
- Consequences
  - Increased machine run time
    - Durability & Cost
  - Unplanned air exchange
    - Extreme thermal conditions
    - Mold, Condensation, & Rot
    - Allergens & Irritants

Duct Leakage

- Supply Side Leaks
  - Conditioned air lost
  - Bldg. depressurization
- Return Side Leaks
  - Air pulled in
  - Bldg. pressurization

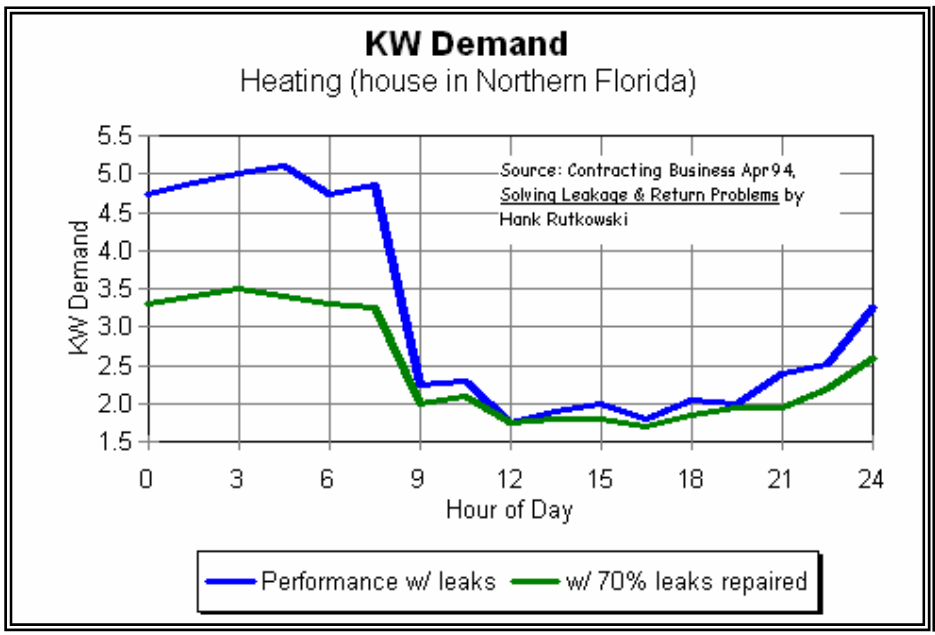
Supply leak

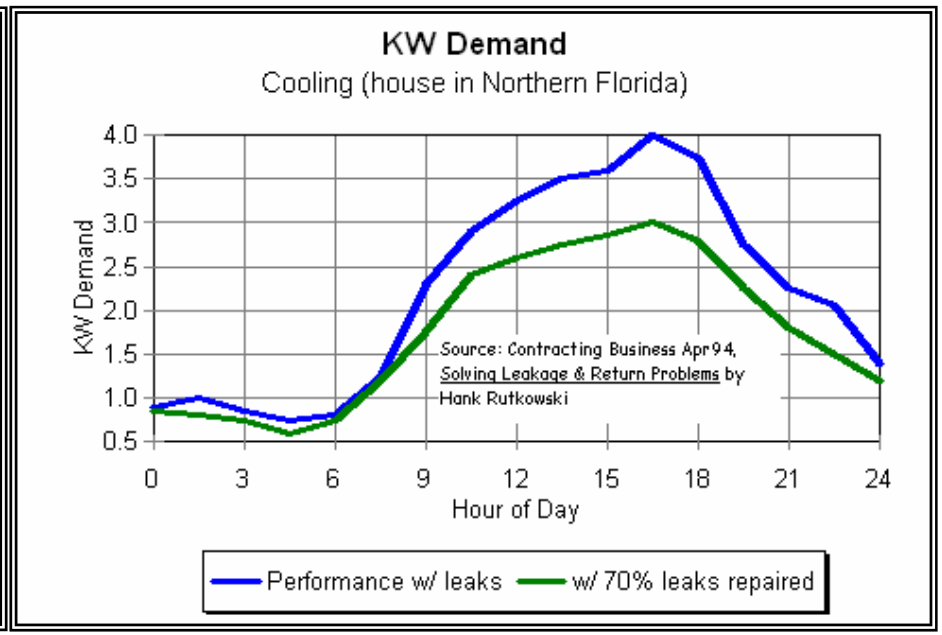
Supply leak

Return leak

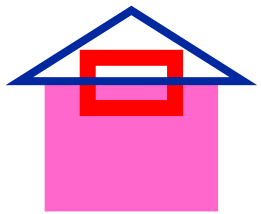
Supply leak

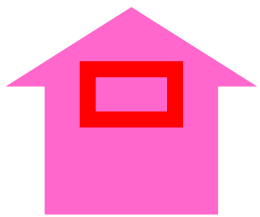
Leakage & KW Demand

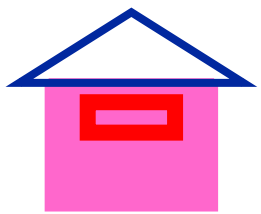




Reducing Impact of Ducts in Unconditioned Spaces

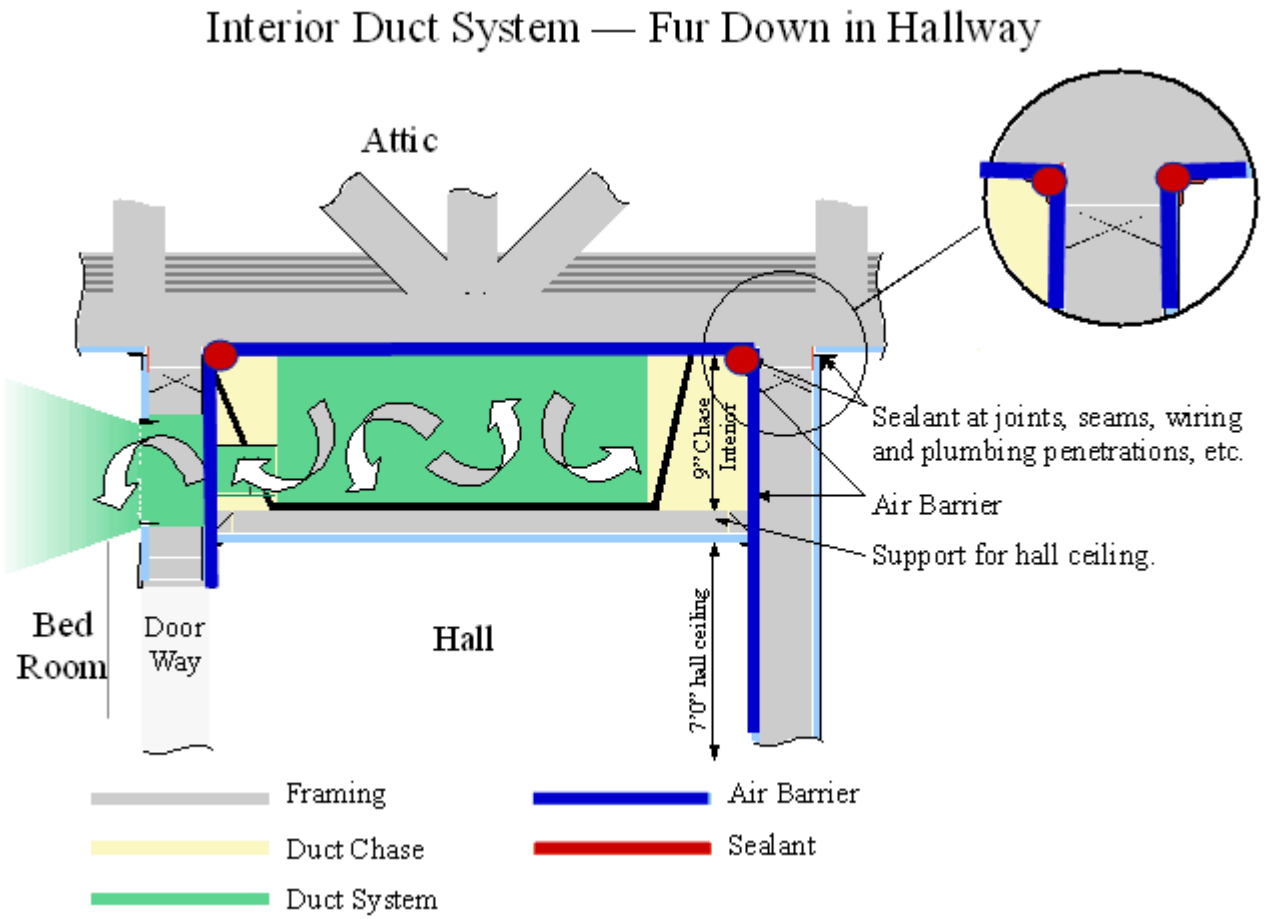






- Sealed and Insulated Ducts: continuous thermal barrier and sealed with mastic and mesh *including the return plenum*.
- Unvented Attics and Crawlspaces – move the air and thermal barriers to the other side of the air distribution system
- Interior Duct Systems – move the air distribution system to the inside of the house's thermal and air barriers.

Interior Ducts - Schematic

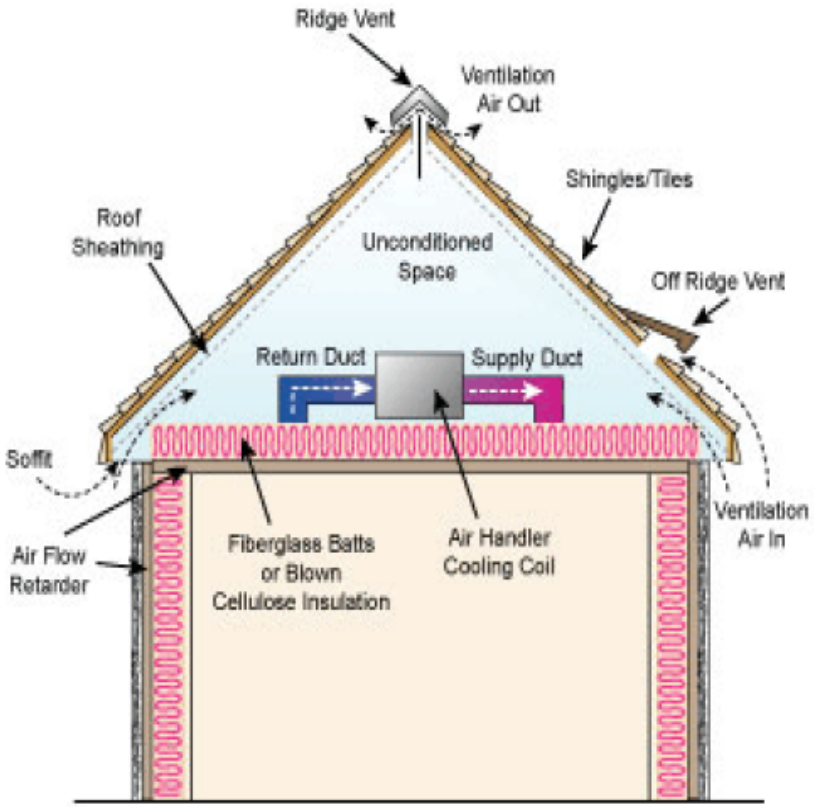


Interior Duct Chases

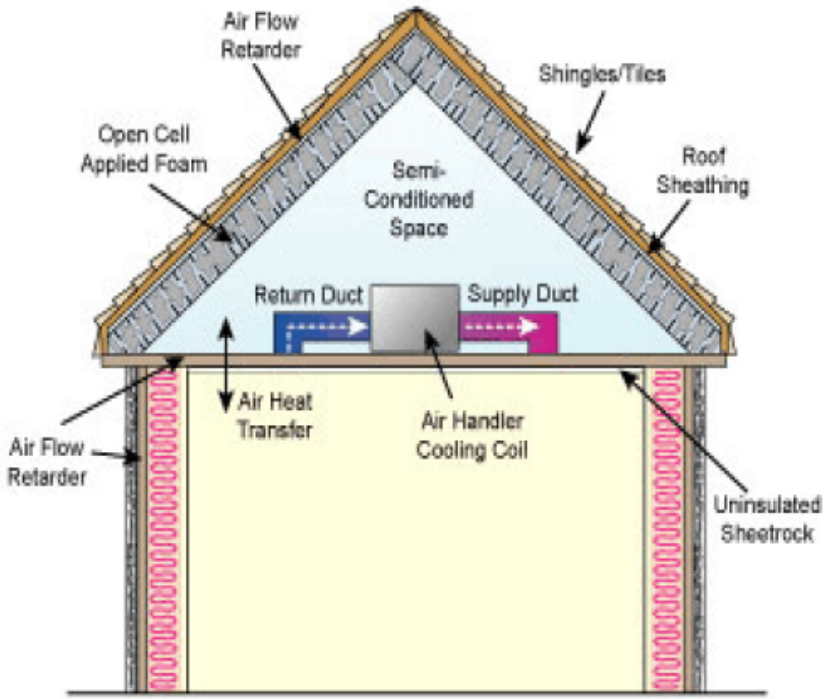
Cost Effectiveness

- Example Economics from North Carolina Houses
  - **$0** No incremental cost for duct installation
  - **+$200** Drywall for miscellaneous air barriers
  - **$0** Ceiling insulation will be thermal barrier
  - **+$350** Labor + materials to install and seal air barrier
  - **- $250** ~1/2 ton reduction in heating/cooling
  - **$300** FIRST COST increase
- Annual Savings = $86
- Simple payback…less than 4 years!

Vented & Sealed Attic Thermal Processes



Vented attic



Sealed attic

Sealed or Unvented Attic

- Equipment
- Storage
- Future expansion

- Energy Savings
- Dry Ducts
- Easy Inspection

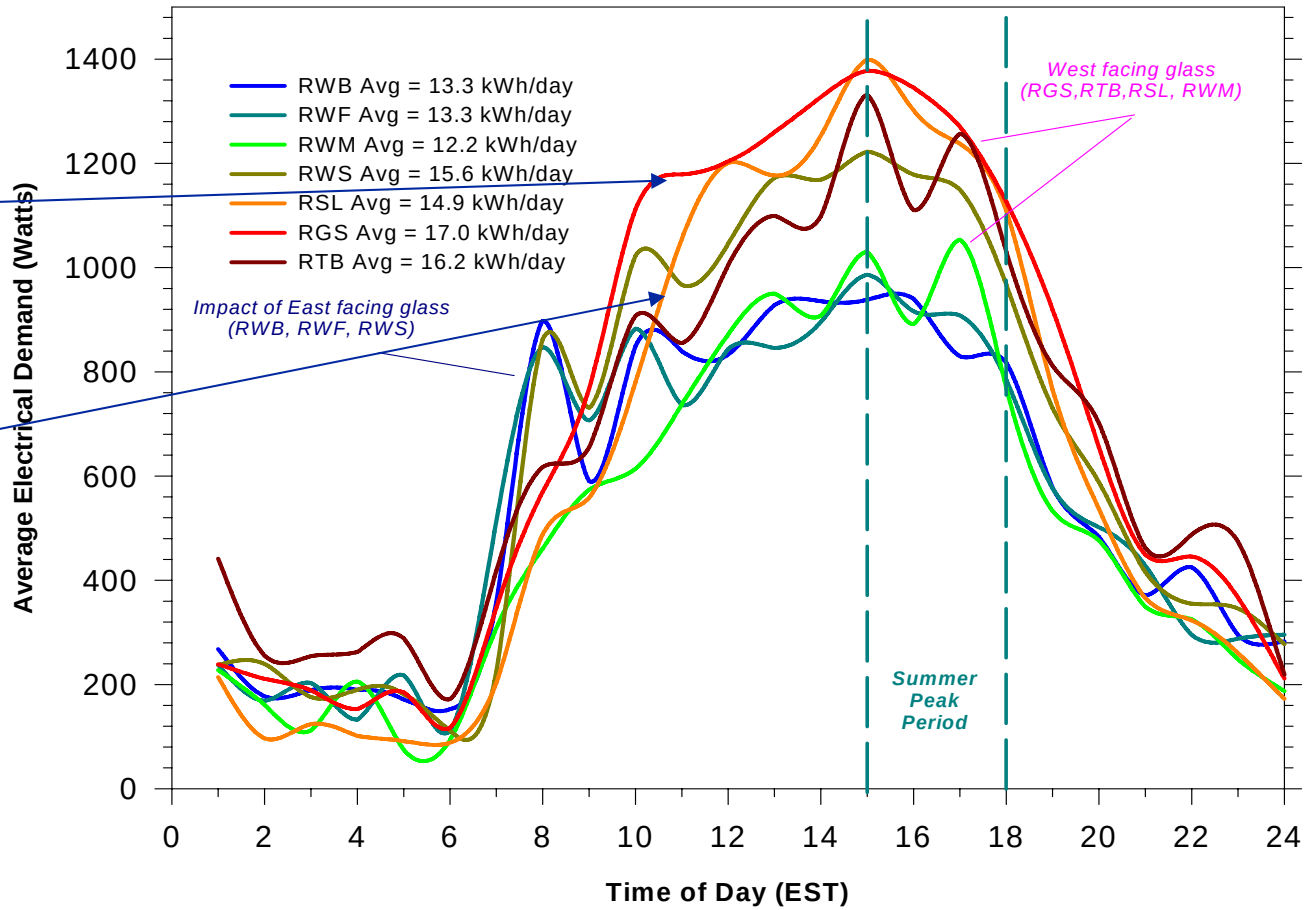
7 Habitat Homes

Case Description	Cooling Savings		Peak Demand Reduction	
	kWh	Percent	kW	Percent
RGS (Control)	0	0%	0	0%
RWS (White Shingle)	300	4%	0.48	17%
RSL (Sealed Attic)	620	9%	0.13	5%
RTB (Terra Cotta Tile)	180	3%	0.36	13%
RWB (White S-Tile)	1,380	20%	0.92	32%
RWF (White Flat Tile)	1,200	17%	0.98	34%
RWM (White Metal)	1,610	23%	0.79	28%

* Percentages relative to typical values for average sized detached S. FL homes

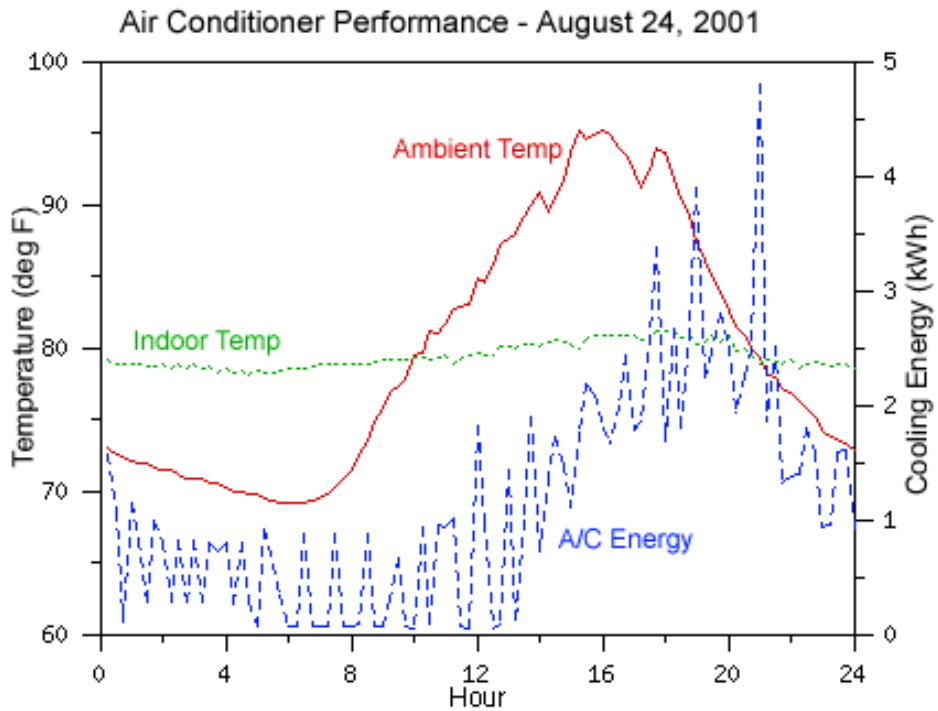
Average Cooling over Unoccupied Period

(RGS) Standard dark shingles (control home)
(RWB) White "Barrel" S-tile roof
(RWS) Light colored shingles
(RWF) White flat tile roof
(RSL) Standard dark shingles with sealed attic & R-19 roof deck insulation
(RTB) Terra cotta S-tile roof
(RWM) White metal roof



Case Study: The Hoak Residence

- 4,250 sqft 2-story w/basement
- 2-speed compressor, 2.5 - 5 ton & variable speed air handler unit
- Heat Pump water heater
- ERV w/backup dehumidifier

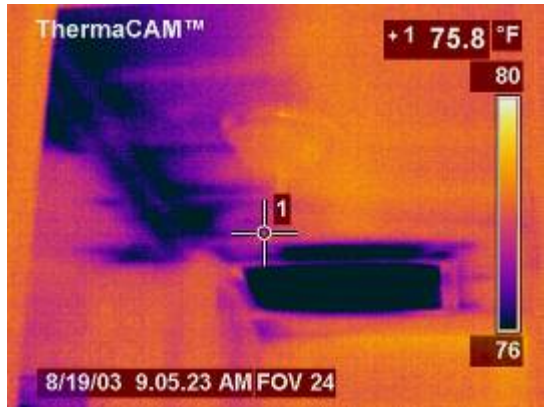


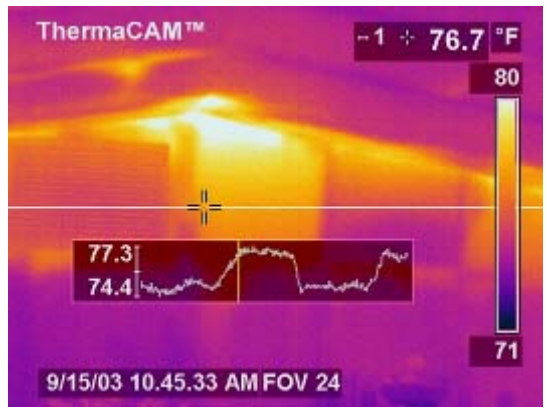
Unvented Attic Benefits

Bonus room conversion

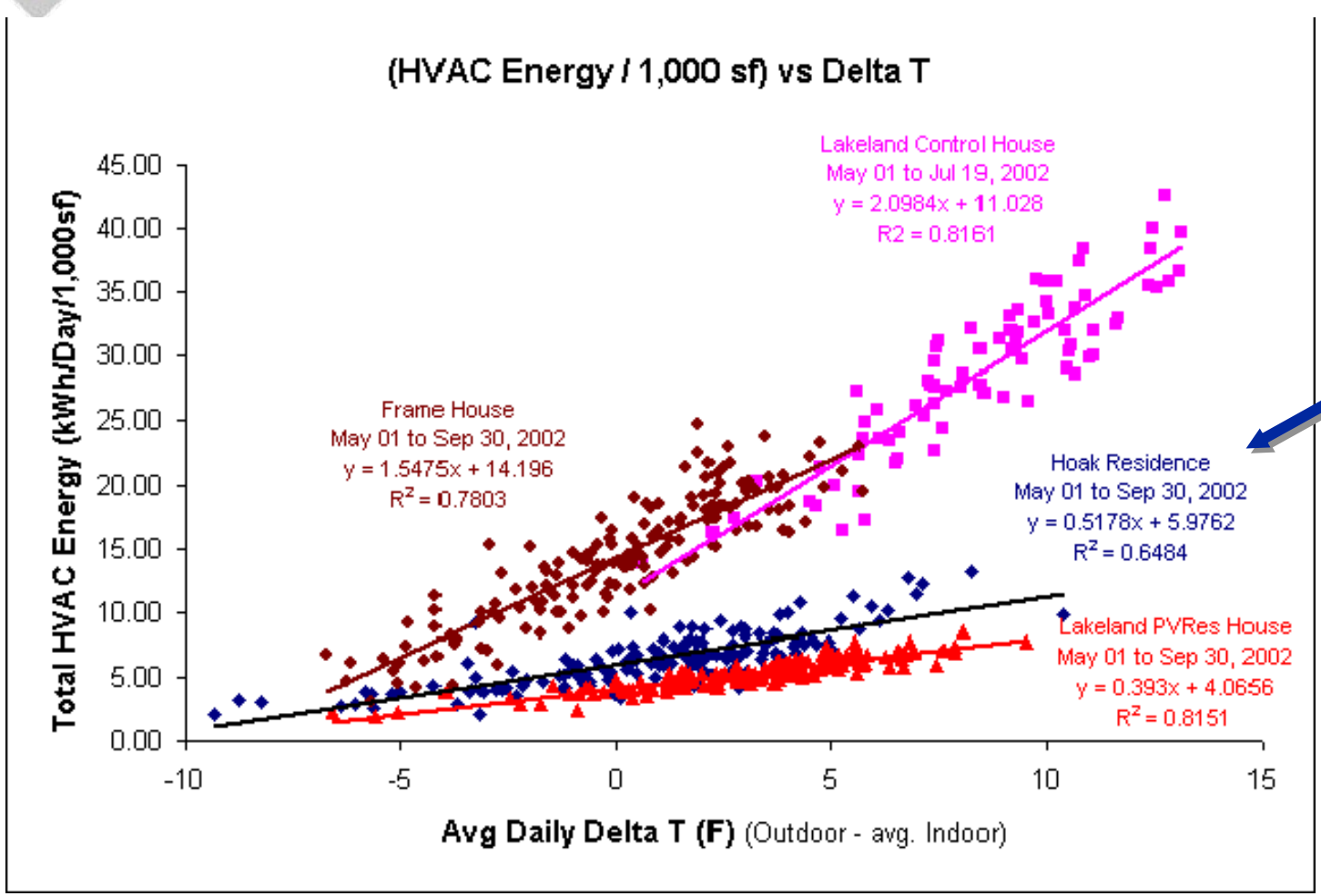
Ducts in conditioned space

Convention Insulation Anomalies

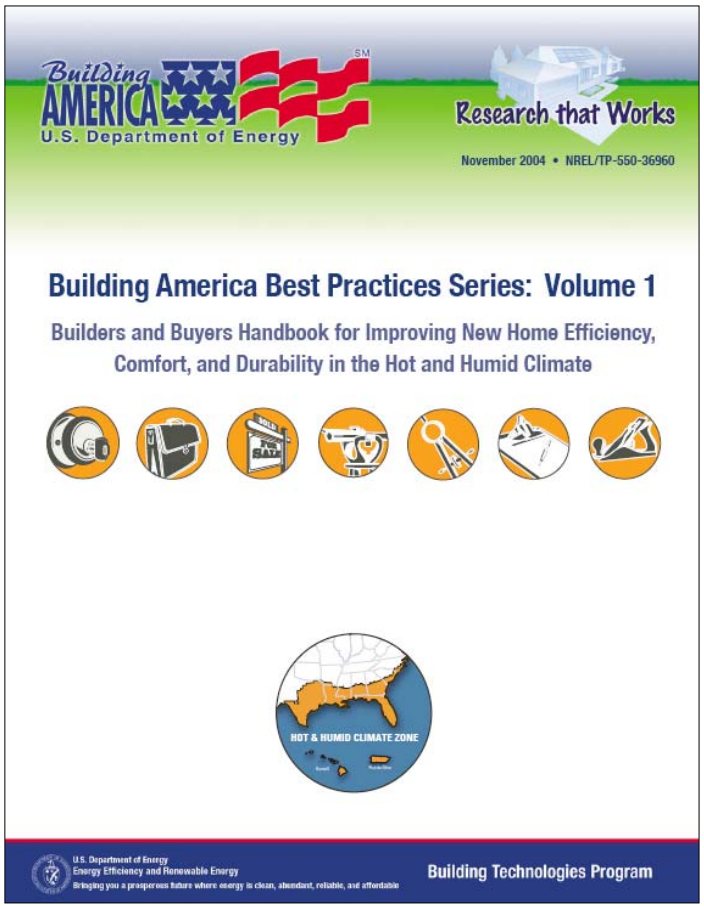


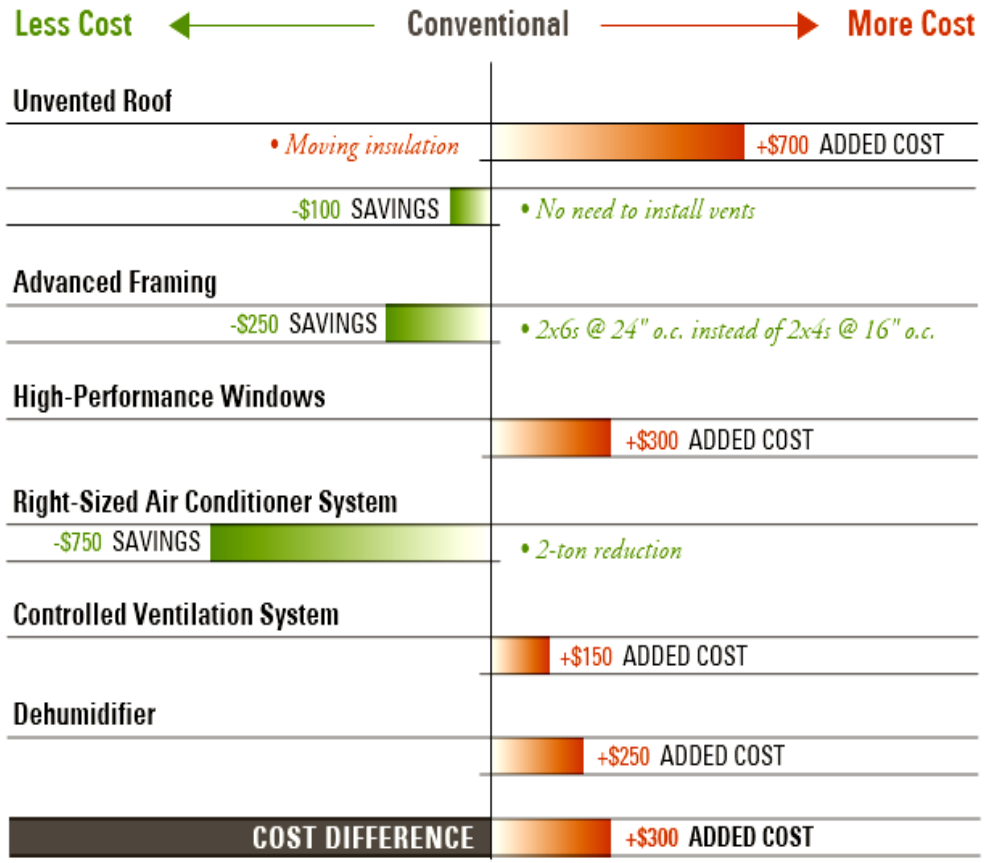


Normalized Energy Use



USDOE Building America





Source: Edminster, Pettit, Ueno, Menegus, and Baczek 2000.

After the Aftermath 2004

Charley – Francis – Ivan - Jeanne

Soffit failure = water entry

Florida Building Code, Residential, 2005 Supplement

CHAPTER 8 ROOF-CEILING CONSTRUCTION

R806.4 Conditioned attic assemblies: Unvented conditioned attic assemblies (spaces between the ceiling joists of the top story and the roof rafters) are permitted under the following conditions:

1. No interior vapor retarders are installed on the ceiling side (attic floor) of the unvented attic assembly.
2. An air-impermeable insulation is applied in direct contact to the underside/interior of the structural roof deck. “Air-impermeable” shall be defined by ASTM E 283.
3. Shingles shall be installed as shown:
   a. For asphalt roofing shingles: A 1-perm (57.4 mg/s . m2.Pa) or less vapor retarder (determined using Procedure B of ASTM E 96) is placed to the exterior of the structural roof deck; i.e. just above the roof structural sheathing.
   b. For wood shingles and shakes: a minimum continuous ¼ inch (6 mm) vented air space separates the shingles/shakes and the roofing felt placed over the structural sheathing.