HERS 101: Education, Equipment, Experience

#### By Brett Dillon IBS Advisors, LLC Builders Energy Rater, LLC







## Residential Energy Services Network (RESNET)

- Created in 1995 by the National Association of State Energy Officials (NASEO) and Energy Rated Homes of America
- Member of Mortgage Bankers Association
   of America
- Oversees the Home Energy Ratings
   System
- Provides Accreditation Standards, Ethical Standards, and Protocols







#### **RESNET Standards 2006**

Went into effect July 1, 2006
Reference home taken from 2004/2006 IECC







### **RESNET's Goal**

- Provide quality control for the industry
- Help Raters become successful in the industry









# **RESNET Seal of Quality**

- Can be used by Raters that adhere to a higher standard of business practices
  - Code of Ethics
  - Rater Financial Interest Disclosure
  - Rater Complaint Resolution Process
  - Rating Standards of Practice

VET RATER









#### Standards of Practice

- Establishes Rater responsibilities
- Allows other Rater services
- Ensures accuracy and consistency of Ratings









#### Rater Responsibilities

- Inspect & test the minimum rated features of the home
- Enter the data into a RESNET accredited software tool
- Provide the client with the rating reports generated by the software









# Rater Code of Ethics

- 1. Professional Conduct
- 2. Representations of Services & Fees
- 3. Conflicts of Interest









# Professional Conduct

- Objective ratings & recommendations
- Participate in Quality Assurance program
- Behave professionally
- Report those who don't
- Maintain certifications
- Comply with technical standards and procedures
- Maintain client confidentiality
- Commit to continuing education









### Representations of Services & Fees

- Don't lie or misrepresent qualifications
- Fully disclose all charges, scope of service provided prior to performing any work
- Do not inspect for a fee a home in which the Rater has any financial interest
- Disclose in writing any compensation or commission from other parties related to work performed by the Rater Copyright© 2007, IBS Advisors, LLC









# Standard Disclosure

- Given to rating client
- Made available to homebuyer/owner
- Conflicts of interest prohibitions waived with advance disclosure

#### RESNET HOME ENERGY RATING Standard Disclosure

For ho	me located at _316 Brasher				
City:	Euless		State:	тх	
1. [	The Rater or the Rater's employer is receiving a fee fo	or providing	the rating on th	is home.	
2. 🗌	In addition to the rating, the Rater or Rater's employe home:	r has also p	rovided the follo	owing consultin	g services for this
	🗌 A. Mechanical system design				
	B. Moisture control or indoor air quality consulting				
	C. Performance testing and/or commissioning other than required for the rating itself				
D. Training for sales or construction personnel					
	E. Other (specify)				
з. [	The Rater or Rater's employer is:				
B. The mortgagor for some portion of the financed payments on this home					
	C. An employee, contractor or consultant of the electric and/or natural gas utility serving this home				
4.	The Rater or Rater's employer is a supplier or installer of products, which may include:				
		Installed	in this home b:	OR Is in the	business of:
	HVAC systems	Rater	Employer	Rater	Employer
	Thermal insulation systems	Rater	Employer	Rater	Employer
	Air sealing of envelope or duct systems	Rater	Employer	Rater	Employer
	Windows or window shading systems	Rater	Employer	Rater	Employer
	Energy efficient appliances	🗌 Rater	Employer	🗌 Rater	Employer
	Construction (builder, developer, construction contractor, etc.)	Rater	Employer	Rater	Employer



Other (specify);

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<< Report







-

Rater Employer

Rater Employer

# **Conflicts of Interest**

- When a conflict of interest arises, Rater shall not perform any more work until full disclosure is made to the client and Provider, and waived in writing by all parties
- No double dipping (unless authorized by all parties)
- Client must be informed of their right to competitive bids
- Rater shall not allow interest in any business to affect rating









### Consumer Complaint Resolution Process









#### Provider Has QAD

- Quality Assurance Designee
  - Field inspects 1%
  - Reviews 10% of software files









#### Provider is responsible to "Provide"

- Must be within 5% of annual heating, cooling and water heating load MMBtu's
- QAD must pass a 2 hour test with 100 questions and score over 90% correctly







### **Quality Assurance**

- Ensures consistent results among all Raters
- Maintains public trust in Ratings industry
- Encourages
   Raters to perform at their best









# QAD

- Selects the homes for the QA rating
- Does not need the Rater's permission









#### Tip: Have complete, accurate and welldocumented rating files









#### **Blower Door**

Measures actual air leakage of home at elevated test pressures, providing comparison to other homes

Helps find leak paths

Can find pressure imbalances

Pressure is measured in Pascals (Pa).

10 Pa = 0.04 inches of water column (w.c.)

25 Pa = 0.10 inches w.c.

50 Pa = 0.20 inches w.c.

75 Pa = 0.30 inches w.c.



Houses are depressurized to - 50 Pa and tests are performed according to ASHRAE Standard 119 as modified by RESNET.









# Rings

- Rings restrict the airflow through the fan, increasing fan pressure. As fan pressure increases, the accuracy of the test increases.
- Smaller & tighter homes typically need smaller rings
- Larger & leakier homes typically need the open fan







DG-700 Pressure & Flow Gauge Device config Mode time avg

#### DG-700 in PR/Flow @ 50 Mode:

Automatically calculates the fan flow for 50 Pa, using the Can't Reach 50 Factors

#### DG-700 in PR/Flow Mode:

Does not calculate fan flow for 50 Pa, but shows the fan flow for whatever pressure the house is at

#### DG-700 in PR/PR Mode:

Does not calculate the fan flow at all. Once house is depressurized to -50 Pa w.r.t. the outside, must look up the fan pressure on the chart using the correct ring column to find the flow rate.







#### **Duct Blaster**

Duct systems are pressurized to + 25 Pa with respect to the outside. Tests are conducted according to ASHRAE Standard 152 as modified by RESNET.

Duct leakage can be measured as either leakage to the outside or total leakage.









### Measuring Air, Heat & Moisture

- As a Rater, you may find it useful to measure airflow with an airflow meter
- Thermometers and RH meters are also useful when diagnosing building performance issues











### How I Got Started

- 4<sup>th</sup> generation carpenter & builder
- Saw a need to change the way I built homes
- Learned how to build better homes
- Saw a need for others to change how they design & build homes
- Help others design & build homes for comfort & durability







#### The Myth of the Entrepreneur

 Because I'm good at what I do, I can make more money working for myself!









# **Reality Check!**



 Every year over 1,000,000
 businesses are started

Year 1: 600,000 in business Year 5: 200,000 in business Year 10: 40,000 in business

The reason for the failure rate is the assumption of the entrepreneur that if they understand the technical work of a business, they understand a business that does that technical work.







### To Succeed:

- Entrepreneur
  - Visionary
  - Creative
  - Strategist
  - Change maker
- Manager
  - Order
  - Controls
  - Systems
  - Predictability
- Technician
  - Does the work
  - Thinks about the work
  - Wants more work
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### **Typical Business**

- 1. "I'll do all the work myself"
- 2. "I'll hire someone to do the work"
- 3. "If I want it done right, I'll have to do it myself"









# Successful Business

- Technician: "How much can I do by myself?"
- Manager: "How many technicians can I effectively supervise?"
- Entrepreneur: "How many managers can I effectively supervise?"







#### Do You Own a Business or a Job?

- Works for wages
- Does the work Manages work
- Plans the work
   Plans growth
- Works for profit



The difference is your perspective!







# **Successful Perspective**

- How must the business work?
- Business is system for producing results for customer resulting in profits
- Vision of the future with a path for changing the present to meet that vision
- Business is a whole derived from parts









# **Successful Perspective**

- Integrated vision of the world
- Present is modeled after the vision
- Business is network of integrated components that contribute to systemic success
- Starts with the customer and creates the business to meet their needs







# **Business Model**

- Innovation
  - Differentiate ourselves from the competition by the way we do business
- Quantification
  - Measure the effects of change
- Orchestration
  - Predictably deliver to the customer what they want every time







# Begin with the End in Mind

- Primary Aim
  - At the end of your life, what will your biographer write?

#### Obituary

Brett Dillon, General Manager of IBS Advisors and noted author, lecturer and adventurer, died in his sleep early this morning at his villa in Hawaii. He was 110 years old and is survived by his wife, 4 sons, 12 grandchildren, and 32 great-grandchildren. His family were all present at the estate due to the annual "Treasure Hunt" family reunion.

Brett co-founded IBS Advisors, an international construction consulting firm, in San Antonio, TX, at the age of 38 and grew it into a multi-million dollar business which the family still runs.







### **Business Model**

- Strategic Objective
  - Opportunity Worth Pursuing



- What are your true products? What are people really buying from you?
- What vehicle do you sell them?
- Who is buying your products and why?






- Strategic Objective
  - Put dates on your plan
  - Describe your plan and timeline









- Strategic Objective
  - Retail pricing
  - -Wholesale pricing









- Strategic Objective
  - Owners Manual that details reporting standards, cleanliness, clothing, customer service, management, hiring, firing, training and corporate culture



















- Go to work on business by working in the business, starting at the bottom
  - Salesperson
    - Innovate, Quantify, Orchestrate
    - Write Sales Operations Manual
    - Hire Sales person to replace
  - Sales Manager
    - Innovate, Quantify, Orchestrate
    - Write Sales Manager Operations Manual
    - Hire Sales Manager to replace
  - Marketing Vice President
    - Innovate, Quantify, Orchestrate
    - Write Marketing Operations Manual
    - Hire Marketing Vice President to replace Copyright© 2007, IBS Advisors, LLC







- Manage through a designed System, not people!
- Systems are predictable, people aren't
- Systems streamline decision making processes
- Customers like predictability and ease of doing business with you. Make your business predictable and easy to do business with.

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The way you do your work reflects you; in the customer's eyes, YOU are the Company!

 Operations manuals tell you exactly how to do the work so the customer gets what they expect (peace of mind, comfort, hope for the future, etc)







- The customer isn't always right, but it is our job to make them feel that they are
- Everyone who works here should work to be the best they can be for the tasks they are responsible for
- The business is a place where everything we know how to do is tested by what we don't know how to do; this conflict creates growth which creates meaning.















Business Model Marketing System

- Demographics
  - Who is buying?
  - Reality

- Psychographics
  - Why are they buying?
  - Perception

Find a perceived need and fill it!







## The Role of a Building Science Consultant







## Call us in early!



### At this point-

- Mechanical Design decisions made
- $\cdot$  Insulation is installed
- $\cdot$  Airsealing is done (or not)
- $\cdot$  Windows are selected
- · Consultant is "outsider"
- My role becomes that of verifier/documenter (and red flag waver)







### The Trades









### "I've been doing this for 30 years..."









### "I've been doing this for 30 years..."











### "I've been doing this for 30 years..."







### "I've been doing this for 30 years..."









### "I've been doing this for 30 years..."









Too often, architects assume that trades know their craft

- HVAC has Manual J load calculation performed correctly
- Ductwork is sized according to Manual D
- Equipment selected according to Manual S
- System is installed correctly by trained technicians







# **Reality Check!**

- Residential mechanical equipment is typically oversized by:
  - -143% to 322% for air conditioning
  - -106% to 234% for heating

Source: <a href="http://www.builtgreen.org/articles/0308\_HVAC\_sizing.htm">http://www.builtgreen.org/articles/0308\_HVAC\_sizing.htm</a>

 Most code officials do not check Manual J load calculations and are not trained to







# Reality Check!

- This problem extends to ME's as well
- Should you rely upon the guy selling you equipment "by the ton" to tell you how much you need?
- ENERGY STAR<sup>®</sup> now requires HERS Raters to verify accuracy of Manual J load calculations







### But if we aren't called in early...









HEATING	
Calculated Peak Load (kBtu/hr)	55.9
Oversize Factor (%)	100.0
HEATING EQUIPMENT CAPACITY (kBtu/hr)	
Required	55.9
Specified	244.0
COOLING	
Calculated Peak Load (kBtu/hr)	44.8
Sensible	40.6 \\ \\
Latent	4.2
Oversize Factor (%)	100.0
Required Total	44.0
Specified Total	122.0
Required Sensible	40.57
Specified Sensible	85.96
Dequired Latent	4.00
Required Latent	4.20
Specified Latent	30.04







## Here's how they got there

Building	Manual J, 7 <sup>th</sup>	Manual J, 7th edition or actual construction	
Design	edition		
Component			
Design	95° F (20 degree difference between inside	93° F (18 degree difference between inside and outside)	
temperature,	and outside)		
summer			
Design	10° F (60 degree difference between inside	18° F (52 degree difference between inside and outside)	
temperature,	and outside)		
winter			
Infiltration	507 cubic feet per minute	Actual from tests: 170 cubic feet per minute	
quantity, Summer			
Infiltration	708 cubic feet per minute	Actual from tests: 292 cubic feet per minute	
quantity, Winter			
1st Floor	0.5 ACH <sub>nst</sub> , default for 900-1500 ft <sup>2</sup>	Actual from tests: whole house, 0.18 ACHnet	
Infiltration,			
summer			
1st Floor	0.7 ACHnat, default for over 2100 ft <sup>2</sup>	Actual from tests: whole house, 0.31 ACHnat	
Infiltration, winter			
2 <sup>nd</sup> floor	0.5 ACH <sub>nst</sub> , default for 900-1500 ft <sup>2</sup>		
Infiltration,			
summer			
2nd floor	0.7 ACHnat, default for over 2100 ft2		
Infiltration, winter			
3 <sup>rd</sup> floor Infiltration,	0.5 ACHnat, default for 900-1500 ft <sup>2</sup>		
summer			







3rd floor Infiltration,	0.8 ACHnat, default for 1500-2100 ft <sup>2</sup>		
winter			
Foundation type	Unconditioned open crawlspace or garage	Conditioned enclosed crawlspace/basement, insulated foundation walls	
Floor portion of	Between ambient and conditioned space,	Adiabatic (between conditioned space and conditioned space)	
building envelope	hardwood floor @ R-19		
Above grade walls	R-19 w/ ½" EPS board (R-1.8), 6,192 ft2	R-13 + R-4.3 EPS board, 2,504.9 ft <sup>2</sup>	
-		R-19, 2,199.9 ft <sup>2</sup>	
Windows & Glass	Wood frame, double pane low-e windows,	, U-factor 0.37, SHGC 0.24	
Doors	no internal shading or overhangs	U-factor 0.48, SHGC 0.49	
	Wood frame, double pane low-e French	Manual J, 7 <sup>th</sup> edition: supposed to account for external	
	doors, no internal shading or overhangs	overhangs and internal shades	
		Actual construction has external shaded glass	
Window area	812 ft <sup>2</sup>	1,032.8 ft², incl. glass doors	
Glass door area	140 ft <sup>2</sup>		
Door area	40 ft <sup>2</sup>	54.5 ft <sup>2</sup>	
Appliance load	3,600 Btuh	Manual J, 7 <sup>th</sup> edition: 1200 Btuh	
People load	21 people living in the home	Manual J, 7 <sup>th</sup> edition: 10 people max	
Volume of house	60,680 ft <sup>3</sup>	56,627 ft <sup>3</sup>	
Ceiling	R-38 under ventilated attic	R-24.3 on roofline	
Duct gain/loss	R-4, 15%, in unconditioned attic and 5% in	R-6 installed by HVAC contractor, 0% according to Manual J,	
-	crawlspace	totally within conditioned space	
Total Sensible Load 68,881 Btuh, plus additional 25% = 86,102 N		Manual J, 7 <sup>th</sup> edition: in order to take full advantage of heat	
	Btuh	pumps during the heating season, heating heat pumps can be	
		oversized 25% IF this produces a lower balance point, increased	
		heating efficiency load and noticeable reduction in annual	







	operating cost. The units installed are dual fuel and therefore preclude the use of the 25% over sizing.	
Total Latent Load	15,633 Btuh (SHF = 0.85)	5,999 Btuh (SHF = 0.87), Manual J 7 <sup>th</sup> edition
Total calculated vs.	101,735 Btuh calculated	
total installed	122,800 Btuh installed	
	(78% more than calculated before 25% over	
	sizing occurred, 20% more than calculated	
	after over sizing occurred)	

Load calculation appears to be complete fabrication, resulting in ~ 600 sf per ton

Actual SEER rating of "16 SEER" equipment: 14 for the  $1^{st}$  /  $2^{nd}$  floors & 15.75 for the third

Heating oversized 336%, Cooling oversized 174%

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## **HVAC Contractor Ignored**



### Tight Construction







## **HVAC Contractor Ignored**



### All overhangs







# HVAC Contractor Ignored

- High performance windows
- $\cdot$  Sealed, conditioned crawlspace & basement
- Radiant barrier roof system
- All mechanicals inside conditioned space
- Correct orientation of glazing
- Homeowner's desire for high performance
- ·Architect's design intent

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# Why is Bigger not Better?

- Higher initial equipment cost
- Poor dehumidification
- Short cycling
- Large temperature swings in home
- Lower efficiency and higher operating costs
- Shorter equipment life
- Comfort problems for homeowners

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### AND...

- Disqualifies the home from ENERGY STAR certification!
- (Even though it beats the 2006 IECC by 36%)









## ACCA

- Hank Rutkowski, PE, author of Manual J, 8<sup>th</sup> edition, estimates that only 5% to 10% of systems have a Manual J load calculation performed.
- The contractors typically say, "I've never been sued for installing too large a system."









Image courtesy of www.truewestmagazine.com

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### Let's Use Building Science, Energy Modeling & Residential Energy Commissioning

#### About REM/Rate

REM	REM/Rate - Version 12.3 Role: Rater Expires: 01/02/2007 Architectural Energy Corporation Phone: (303) 444-4149 Fax: (303) 444-4304 Copyright © 1985-2006 All Rights Reserved.	
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# On the Next Project:

- Architect called me in early
- I discussed the expected outcome with HVAC contractor (a different one)
- 8<sup>th</sup> edition Manual J load calculation performed by me
- HVAC contractor will select equipment that meets the load profile

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### Result:

Building Loads				
Total Heating Required With Outside	Air: 22,488	3 Btuh	22.488	MBH
Total Sensible Gain:	18,536	6 Btuh	87	%
Total Latent Gain:	2,738	Btuh	13	%
Total Cooling Required With Outside	Air: 21,274	Btuh	1.77	Tons (Based On Sensible + Latent)
Equipment Data				
	Heating System			Cooling System
Туре:	Air Source Heat Pu	Imp		Air Source Heat Pump
Model:	RHF24C2*+CA*F0	37*2*+T	XV+MBR080	RHF24C2*+CA*F037*2*+TXV+MBR080
	0**-1			0**-1
Brand:	RHF Series			RHF Series
Description:	Air Source Heat Pu	ımp		Air Source Heat Pump
Efficiency:	8.3 HSPF			14 SEER
Sound:	0 bels			0 bels
Capacity:	23200 Btuh			23800 Btuh

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## **Compared to Typical**

	Typical Construction		
HEATING			
Calculated Peak Load (kBtu/hr)	53.7	21.9	
Oversize Factor (%)	100.0	100.0	
HEATING EQUIPMENT CAPACITY (kBtu/hr)			
Required	53.7	21.9	
Specified	96.0	24.0	
COOLING			
Calculated Peak Load (NBtu/hr)		16.8	
Sensible		14.4	
Latent	// \ 2.9/	2.4	
Oversize Factor (%)		100.0	

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### These Challenges are Pandemic

- Production builders
- Utility companies
- Custom homebuilders
- Affordable housing providers

#### All are victims of this poor workmanship

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## So, Hire a Building Science Geek



- To help you design the home for maximum efficiency, comfort and durability
- To help ensure the trades execute the design intent correctly
- $\cdot \operatorname{To}$  help sort out code officials
- To achieve tax credits, ENERGY STAR certification, green building verification
- $\cdot$ To help you keep clients happy
- $\cdot \, To$  keep lawyers away from your PL policy

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### Any Questions?



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