HVAC System Performance

A program for existing HVAC systems

IL SAG

Jay Wrobel- April 13, 2010

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What is Systems Improvement

Furnace/Condenser tuning

+ duct improvement

= System improvement

Issue

- Installed efficiency does NOT equal system operating efficiency
- Improving the system can be done on existing or new install HVAC systems
- Systems improvement impacts electric & gas consumption as well as improves comfort
- New high efficiency products in inadequate HVAC systems will reduce overall efficiency!
- Most HVAC programs incent new installs
- Lack of consumer awareness around importance of duct performance

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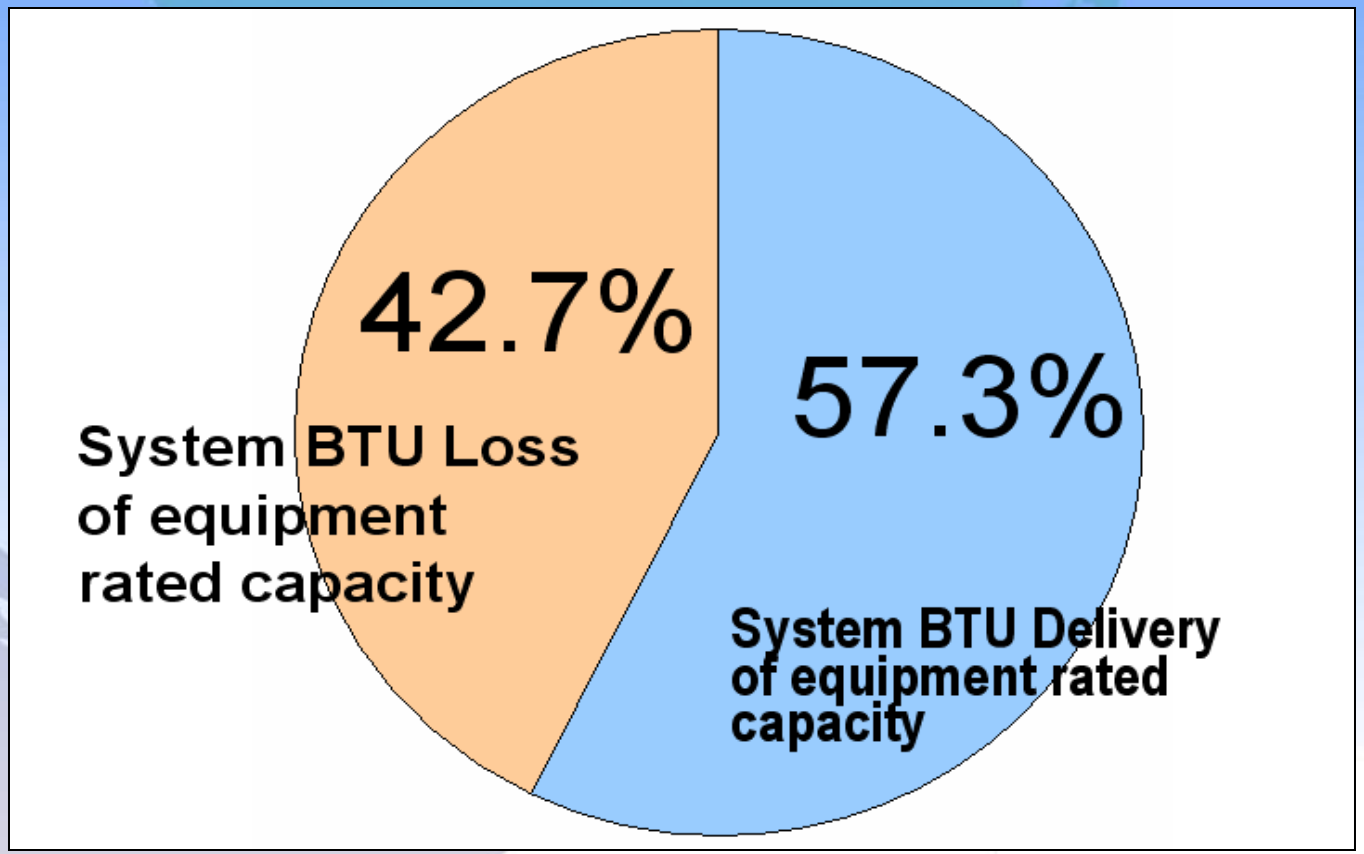
HVAC Reality

The national average shows HVAC systems deliver only 57% of the equipment rated BTU into the building



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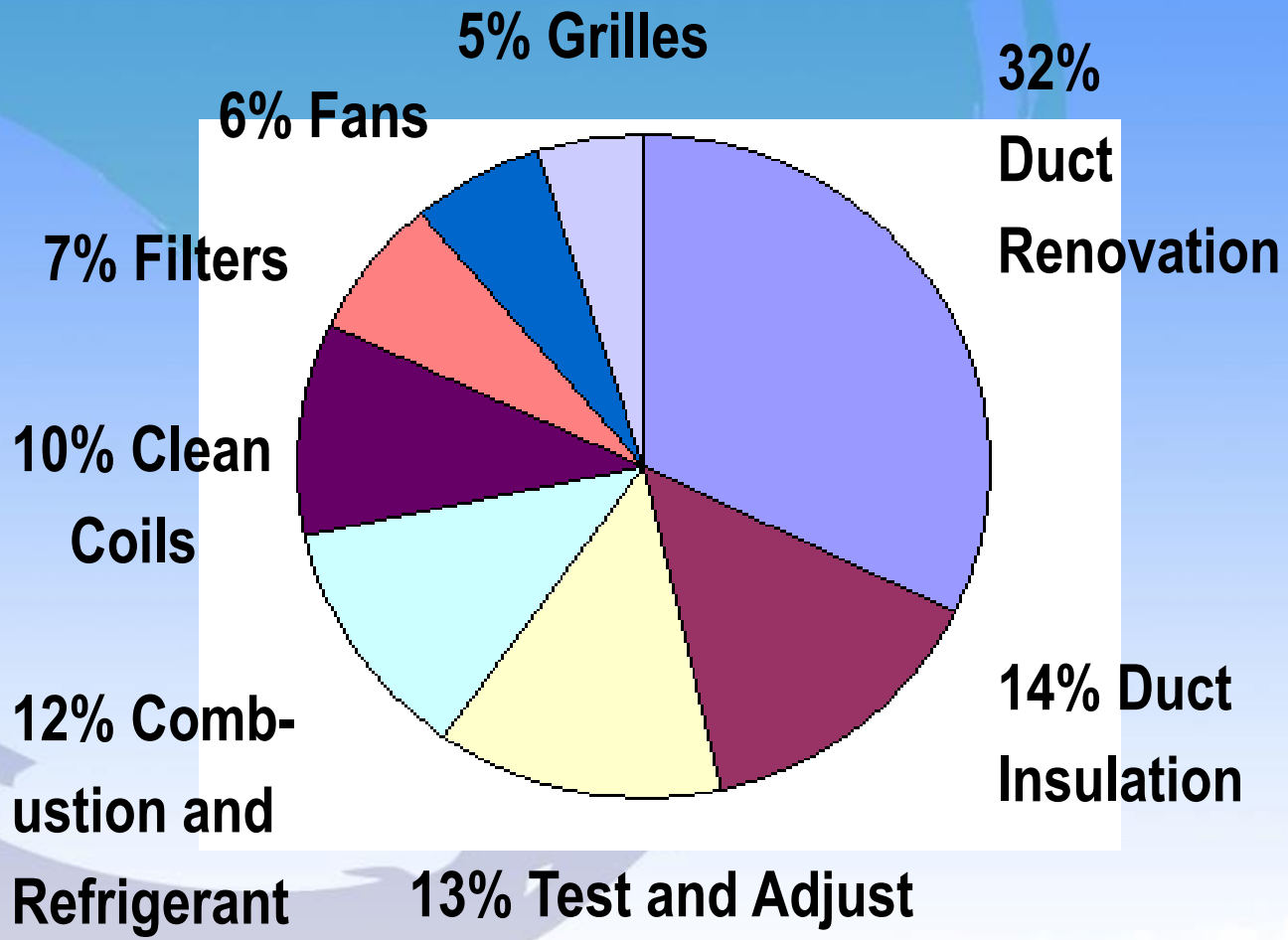
Effect of Typical HVAC System Repairs on System Performance



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Program Vision

- Enhancing duct/system can be more cost effective than upgrading the system
- Train and Certify HVAC contractors to promote and deliver program
- Utilities pay part of audit costs
- Utilities pay a performance improvement incentive to home owner
- Contractors do the systems performance improvement
- Program does QA/QC
- Program reports the data on installed system and performance to utilities for potential follow on program efforts
- Program's HVAC tool reports potential energy savings and gives consumers guidance on actions to take.
  - Makes the marketing/sales pitch and shows consumers the savings potential

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Sample Program Outputs (customer)

PerforMaxx Test-In Report
Potential Savings
Job # ComfortMaxx Test-In Heating
System 1

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Tim Hanes
1111 Main St
Pleasantville, IA 66666
666-666-6666

Indoor Model Number Trane TUX1C100A9
Outdoor Model Number Trane 4TTB4048E
Time 6:30 am **Tech** tmh

EFFICIENCY

	Tested	Target
HSER	28	90 +
Equipment Efficiency	67	90 +
Duct System Efficiency	41	90 +

Equipment Consumption Predictions

	Annual Heating Units	Price per Unit	Annual Cost Heating	Annual Savings Heating
Tested Equipment Efficiency 67%	2000	$1.2	$2400.0	$0
Equipment Efficiency 100%	1337	$1.2	$1604.92	$795.08
Equipment Efficiency 90%	1486	$1.2	$1783.24	$616.76
Equipment Efficiency 80%	1672	$1.2	$2006.16	$395.86

Duct System Consumption Predictions

	Annual Cost Heating	Savings if reduced by 50%	Savings if reduced by 75%	Savings if reduced by 90%
Supply Duct Loss Total	$583.10	$291.55	$437.33	$524.79
Return Duct Loss Total	$245.27	$61.32	$91.98	$110.37

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Sample Program Outputs (customer)

Estimated Savings Test-Out Heating
Job # comfortmaxx test out heating
System 1

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Tim Hanes
1111 Main St
Pleasantville, IA 66666
666-666-6666

Indoor Equipment Trane TUX1C100A9
Outdoor Equipment Trane 4TTB4048E
Time 3:00 PM **Tech** tmh

The total estimated annual heating savings is $1364.21.

EFFICIENCY

	Test-In	Test-Out
HSER	28	71
Equipment Efficiency	67	86
Duct System Efficiency	41	82

Equipment Consumption Predictions

	Annual Heating Units	Price per Unit	Annual Cost Heating	Annual Savings Heating
Test-In Equipment Efficiency 67%	2000	$1.2	$2400.0	$0
Test-Out Equipment Efficiency 86%	1553	$1.2	$1864.17	$536.83

Duct System Consumption Predictions

	Test-In Annual Cost Heating	Test-Out Annual Cost Heating	Annual Savings Heating
Supply Duct Loss Total	$683.10	$0	$683.10
Return Duct Loss Total	$246.27	$0	$246.27

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Sample Program Outputs (customer)

Questions and Answers	
What causes high system pressures ?	A typical cooling system moves over 6,000 pounds of air per hour through your duct system. Air is heavy. Those pounds of air are pushed and pulled through air filters, heat exchanges and often undersized ducts.
Why is airflow so important?	The correct amount of airflow is essential to good system performance. Heat actually travels with the airflow. Low system airflow often means poor equipment performance and reduced equipment life, which may substantially increase maintenance expense. Supply airflow is the total of the airflow pushed out of the supply registers. Return airflow is the total of the airflow pulled into the return grilles.
How does grille airflow affect comfort?	When the airflow into a room is excessive, the room will overheat. When the airflow into a room is less than required the room will be colder than other rooms when the temperature drops outdoors.
Why does airflow loss hurt system performance?	Ideally, all of the heating that the equipment makes would be delivered into the building. Heat lost between the equipment and the rooms reduces comfort and the cooling capacity of the system and increases utility expense.
What are the reasons the system delivered heating is so low?	Until recently, few heating companies have had the ability to measure the amount of delivered heating. This new technology helps us find and repair system defects including low airflow, excessive pressure, poor combustion and venting issues, and duct losses caused by damaged, undersized and poorly installed ductwork.
What does the System Efficiency Ratio mean?	This system efficiency score is a ratio or grade describing the performance of your heating system as determined by the most advanced heating system calculation available in the industry today. If the calculation was made manually, it would take over 24 hours to complete.

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Sample Program Outputs (contractor)

ComfortMaxx Test-In Report
Heating System Testing Data
Job # ComfortMaxx Test-In Heating
System 1

Tim Hanes
1111 Main St
Pleasantville, IA 66666
666-666-6666

Indoor Model Number Trane TUX1C100A9
Outdoor Model Number Trane 4TTB4048E
Time 6:30 am **Tech** tmh

EFFICIENCY

	Tested	Target
HSER	28	90 +
Equipment Efficiency	67	90 +
Duct System Efficiency	41	90 +

Btu/h

	Tested	Target
System Sensible Btu/h	21744	71049
Equipment Capacity Sensible Btu/h (at time of test)	78943	
Equipment Sensible Btu/h	62790	71049
Supply Duct Leakage Sensible Btu/h Loss	17664	
Supply Duct Conductive Sensible Btu/h Loss	7987	
Return Duct Sensible Btu/h Loss	5396	
System Sensible Btu/h Loss	31047	7894

PRESSURES

	Tested	Target	%
Total ESP	0.70	0.5	140%
Filter Pressure Drop	0.17	0.10	170%
Coil Pressure Drop	0.26	0.20	126%
Supply Duct Pressure	0.14	0.10	140%
Return Duct Pressure	0.14	0.10	140%

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Next steps

- Run TRC analysis for gas-electric savings
- Adopt program and set targets (homes, energy, etc)
- Determine # of contractors needed
- Train contractor network
  - 2 day training on systems performance & tool use
- Launch program
- Recruit home owners
- Provide incentives post-improvements
- Quality assurance and post- install testing
- Validate savings through end use billing analysis

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Iowa Utility Pilot

- Utilities using a certified contractor base
- Homeowners are recruited, paying $99 to participate
- Utilities cover balance of HVAC systems audit (~$600)
  - Includes systems performance and home energy audit
    - Blower Door/ Infrared Scan with detailed Air Leakage report
    - Insulation evaluation
    - Lighting and Appliance evaluation
    - HVAC System testing
    - Full test in and test out to verify improvements
- Customers pay for systems improvement (~$2000)
- Utilities provide incentive post-improvement ($200-$400)

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Questions or Comments?

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DUCT RENOVATION 32%

- Repair or replace damaged ducts
- Add new return ducts or increase existing return duct size
- Add new supply ducts or increase existing supply duct size

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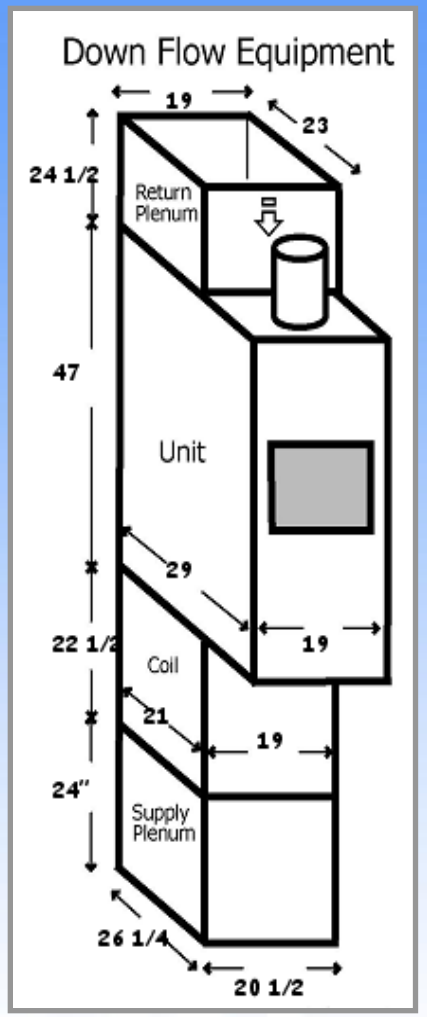
DUCT RENOVATION 32%

- Repair damaged or poorly installed duct joints
- Straighten and extend flexible ducts, increase support and suspension
- Replace restrictive transitions
- Install sheet metal wyes, fittings, and balancing dampers
- Renovate combustion venting and combustion area pressure defects



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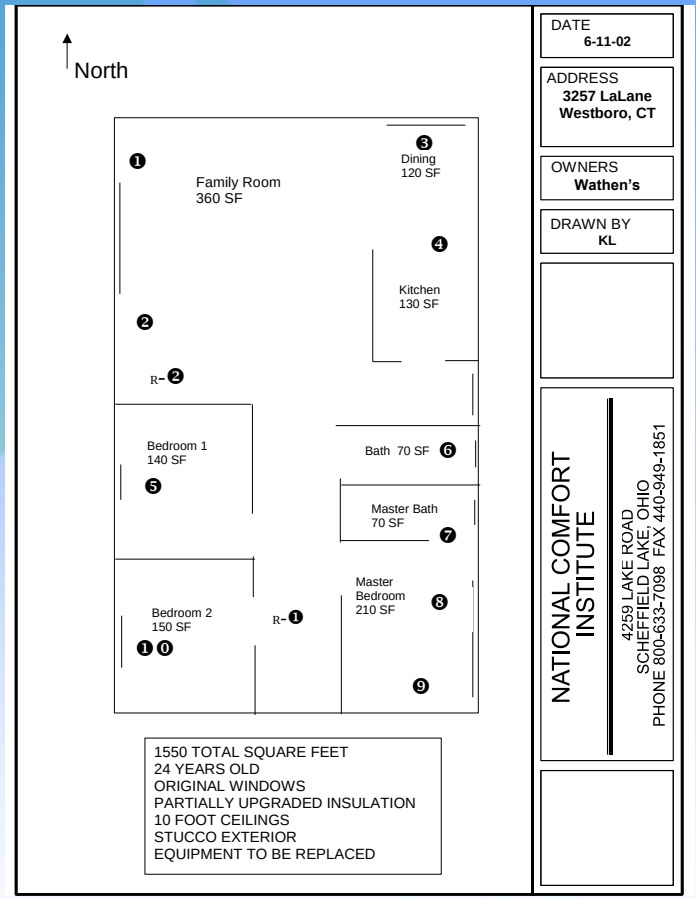
DUCT INSULATION 14%

- **Add duct insulation as required by temperature diagnostic testing**
- **Insulate any bare metal or air distribution components**



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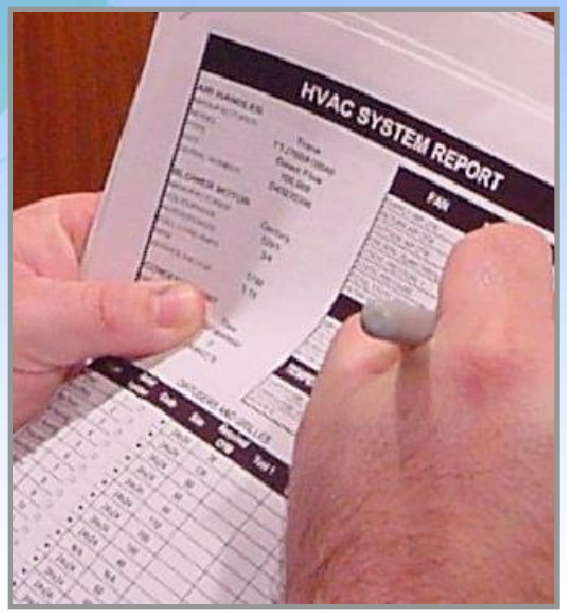
TEST AND BALANCE SYSTEM 13%

- Be sure air is delivered to the right place and is the right temperature!
- Air that doesn't make it to the room you're in will NOT make you comfortable!



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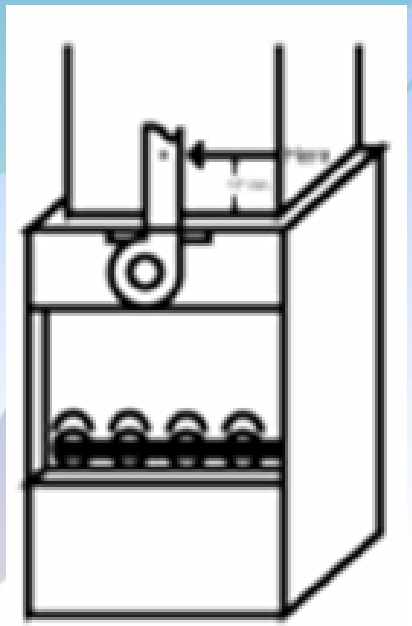
COMBUSTION AND REFRIGERANT ADJUSTMENT 12%

- After system repairs, test and adjust combustion efficiency
- After system repairs, test and adjust refrigerant charge



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CLEAN COILS AND HEAT EXCHANGERS 10%

- Clean or replace cooling coils if diagnostic testing indicates the need
- Clean heat exchangers and heating coils

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FILTERS 7%

- Remove restrictive filters and replace as determined by pressure testing
- Add return air filter grilles or filter housings to increase their surface area

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FANS 6% & GRILLES 5%

- Increase fan speed to required airflow as determined by airflow testing
- Clean and repair or replace fans and fan motors as needed

- Remove and replace grilles and registers as confirmed by BTU measurement
- Tighten connections at boots and grilles

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