Welcome to WaterFurnace
Opportunity to Net Energy
Our building is GeoExchange even the plant and the labs
Our Mechanical System!

Pumps & Headers
just add water
Fundamental Change!

If nothing changes – how can you get new results?

• Release Creativity
  – Application knowledge
  – Code
  – Contracts

• Team versus – “low bid!”
  – Do NOT Buy everyone’s mistakes
  – Are Projects too complex to maintain?
    • Artificial efficiency
    • Modeling accuracy
    • WSHP – simple and efficient by DESIGN even by DEFAULT
Back in 2011 multiple design guides were produced. They all encourage the Integrated Design Process and they all featured WSHP’s as a possible solution.

Advanced Energy Design Guide for Small to Medium Office Buildings

Achieving 50% Energy Savings Toward a Net Zero Energy Building

Developed by:
American Society of Heating, Refrigerating, and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy
Kickoff thru O&M
the GREEN Team

The integrated design process is the path to Net Zero

Advanced Energy Design Guide for Small to Medium Office Buildings
Common sense evolution

• 1950’s – water-cooled better than air-cooled
• 1960’s – Closed loops in buildings
  • Installed cost
• 1970’s – Energy transfer
• 1980’s – exploded in offices and schools
• 1990’s – EER and extended range expansion
• 2000’s – Refrigerant, EER, and ECM
System Selection

**OPR** – Owner Project Requirements

- The owner wants to know options
  - Budget
  - Why use a system?
    - Installed cost
    - Operating cost
    - Space – interface cost
    - Reliability and risk
  - Function is required

- Redundancy for example
## Energy Efficiency

### Lessons Learned ... By a utility

<table>
<thead>
<tr>
<th>Heat Pumps</th>
<th>Projected kW Reduction</th>
<th>Actual kW Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Source Heat Pumps</td>
<td>0.33 kW/ton</td>
<td>0.165 kW/ton</td>
</tr>
<tr>
<td>Ground Source Heat Pumps</td>
<td>0.66 kW/ton</td>
<td>0.65 kW/ton</td>
</tr>
</tbody>
</table>

(2.6 kW/4T home)

- 93% of rebates paid on “Replacement “& “New Construction”
- 80% paid on Air Source & 20% paid on Ground Source Product
- 60% return on rebate program

### To accomplish our goals we must ... 

- **Focus on Ground Source & C&I and flip the historical ratio**
- **Be able to play in the replacement game**
- **Transitioning away from “Consumer Rebates”**

### Air Source returned

- Half of calculated
- Why?
  - SEER vs. EER
  - Water-cooled vs air-cooled
  - Loop vs. Ambient
EER vs. SEER vs. IEER

S and I are already adjusted ratings

How The Culture of Inefficiency Is Outfoxing LEED®, ASHRAE, And Efficiency Programs

How many energy-efficient or certified buildings are not living up to the label? Very, very many, if this Ohio commissioning/auditing firm’s experience is close to typical. They report on common weaknesses in efficiency strategies and on real-life patterns of upgrades gone wrong across an array of equipment types. While flaws in well-intentioned processes remain, a more careful investment of human energy can still yield the desired reduction in building energy.

BY PETER KLEINHENZ, MS, P.E.; JOHN SERYAK, MS, P.E.; CHARLIE SCHREIER, MS, P.E.; FRANC SEVER, MS; AND GREGORY RAFFIO, MS, P.E.
Benchmarking (LL84) - reporting

Coming to a city near you – report Energy and Water use
A Stable Whole Building Performance Method For Standard 90.1

By Michael Rosenberg, Member ASHRAE, and Charles Eley, P.E., FAIA, Member ASHRAE

Wouldn’t it be great if a single energy model could be used to demonstrate minimum code compliance, green code compliance, establish a LEED rating, and determine eligibility for federal tax and utility incentives? Even better, what if the basic rules for creating those models did not change every few years?

A recently proposed addendum to ANSI/ASHRAE/IES Standard 90.1-2010 aims to meet those goals. Addendum bmb establishes the Performance Rating Method found in Appendix G of Standard 90.1 as a new method of compliance while maintaining its traditional use in gauging the efficiency of “beyond code” buildings. Furthermore, the addendum sets a common baseline building that would stay the same for 2013 and future versions of Standard 90.1, while only the improvement target will change with each new edition.

Background

used for code compliance and the Performance Rating Method (PRM) used for LEED calculations and other beyond-code programs. The performance methods are similar in that the design or proposed building is compared to a baseline building that is in compliance with the prescriptive standards. The differences are in the details of how the baseline is defined and the scope of design elements that can be credited.

The ECB method is intended to be used for code compliance, and as result, the baseline building tracks the proposed design in many respects. For example, if served by a water-source heat system, the comparison is to a building with wood-framed 20% window-to-wall ratio, all facing south, served by a water heat pump system, with all cor just meeting prescriptive requ. If the same building had ma a 40% window-to-wall ratio, dows facing west, and an air-so pump system, the comparison to a baseline building with mas 40% window-to-wall ratio, all facing west, and an air source h system, with all components just meet- ing prescriptive requirements.

About the Authors

Michael Rosenberg is a senior research scientist at Pacific Northwest National Laboratory, Eugene, Ore. He is a member of the SSPC 90.1 Energy Cost Budget Subcommittee and the LEED Energy and Atmosphere Technical Advisory Group. Charles Eley, P.E., FAIA, is a consulting architect and mechanical engineer in San Francisco.
Department of Energy is taking action to enhance collection and use of data.

STANDARD ENERGY EFFICIENCY DATA PLATFORM

The Standard Energy Efficiency Data (SEED)™ Platform is a software application that helps organizations easily manage data on the energy performance of large groups of buildings. Users can combine data from multiple sources, clean and validate it, and share the information with others. The software application provides an easy, flexible, and cost-effective method to improve the quality and availability of data to help demonstrate the economic and environmental benefits of energy efficiency, to implement programs, and to target investment activity.
## Whole Building Approach

### Energy Profile:

<table>
<thead>
<tr>
<th>Category</th>
<th>Heat</th>
<th>Cool</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>People</td>
<td>Heat</td>
<td>Cool</td>
</tr>
<tr>
<td>Ventilation Air</td>
<td>Heat</td>
<td>Cool</td>
</tr>
<tr>
<td>Lights and equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plug Loads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>Heat</td>
<td></td>
</tr>
<tr>
<td>Unoccupied</td>
<td>Heat</td>
<td>Cool</td>
</tr>
</tbody>
</table>
Do you have both?

• Heating and Cooling
• WSHP system advantage – Nets loads
  – WSHP’s are available from small units sized for a 200 sq. ft. room to 12000 sq. ft. core of the building
  – WSHP’s reverse
    • Heat or cool independently
    • BUT – all tied together to cancel each other out
      – Heat and cool simultaneous
      – Heat and cool cyclically
        » Cool during occupied then heat unoccupied
        » Cool people then heat water
        » *Hot water is in PIPE, HVAC in pipe helps tie them together to net energy of the entire building*
Commercial Products

Horizontal and Vertical Products

- Versatec Base Series 1/2 to 6 ton
  UBH and UBV Models

- Versatec Ultra Series 3/4 to 6 ton
  USH and USV Models

- Envision2 Compact Series 3/4 to 6 ton
  NBH and NBV Models
  Single and Dual Capacity

- Versatec Condo Replacement 1-1/2, 2, 2-1/2 and 3-1/2 ton
  UCV Models

- Envision Series 6 to 25 ton
  NLH/NXH and NLV/NXV Models
Commercial Products

Console Products

• **Envision Console Series** 1/2 to 1-1/2 ton
  NCS Models – Slope Top Cabinet
  NCW Models – Flat Top Cabinet
  NCC Models – Chassis Only

• **Envision Low Sill Console Series** 1/2 to 1-1/2 ton
  LCS Models – Slope Top Cabinet
  LCW Models – Flat Top Cabinet
  LCC Models – Chassis Only

**22.5” H x 45.1” x 10.8”**
Variable Technology Opportunities
EC Motors

ECM 2.3 - Electronically Commutated Motor

- More Efficient – Increases AHRI certified EER/COP
- Maintains constant CFM
- Quiet
- Soft Start at low speed – single compressor with multi-speed blower
- 5 to 12 CFM settings/unit – choice of CFM per ton

Payback is less than 2 years!

The ECM Blower turns the WSHP into a variable speed air handler that can be remote from the space served and automatically respond to changes in duct design or installation.
Base Control Board or Communicating

ECM at choice from 5 or 12 speed motor

Thermostat

Base Control Board or Communicating

Compressor

Hand Held Tool
Water heating?

WSHP’s that are available Water to Water
Different than a chiller or the same? Depends...
Condenser water cooling is more efficient than air-cooled
WSHP loop is a net energy loop over a range for heat and cool
   The compressor circuit works against more favorable temperatures not outside
   air temperatures, but the designed and controlled loop temperature range.
   » The equipment works like it is spring or fall all year
   » The loop is a range, easier to control versus a set point
   » From 40F to 100F even more the units will heat or cool
     • Easy, forgiving, and Net Energy
     • Green Technology Compatible
     • System life over 20 years

Do not operate a boiler and a cooler at the same time for HVAC and water heating.
If you use hot water you need WSHP’s
Radiant heating and cooling

Water-to-Water units are chillers and they are

• NOT
  – They are not air-cooled
  – They do not depend on a fixed condenser water temperature
  – They do not have to deliver only chilled water

• Are – reversible
  – Variable temperature output
  – Hot Warm Cool Cold – you choose, even simultaneous
  – Or two hot temperatures or two cold for coils and radiant
Commercial Products

Water to Water Products

- Envision Reversible Chiller Series
  NXW Models
  8 to 50 ton
  60 to 300 ton

- Envision Water to Water Series
  NDW Models
  6 to 12 ton

- Envision Hydronic Series
  NSW Models
  3/4 to 6 ton
Never pay for heating and cooling at the same time

• Options
  – Building needs heat – operate high efficiency boiler
  – Building has excess heat operate Fluid Cooler
  – Geothermal
    • Reject excess heat to ground
    • Extract heat from the ground
  – Hybrid
    • Combination of all of the above to meet the budget
GOAL: “THE” or Multiple - Net Energy Solutions
One Compressor

- Large Variable speed or staged Water to Water
  - Hot water to cold water - direct
  - Not one compressor to heat then one to cool

- Start at 60 tons and up

- Need a source of heat or to reject excess
  - Simultaneous, take heat from one loop add to cool loop. When one is satisfied the other goes to part load capacity.
  - It is your energy – use it wisely
WSHP installed Advantages

• Less pipe – 2-pipe system even 1-pipe option
• Multiple sizes and function
• Multiple Certified Manufacturers
• Demand Control – Energy Monitored or Billed
  – Comfort
  – Compressor horsepower
  – Blower horsepower
  – Pump horsepower
WSHP vs. VRF the facts
An Example in the ASHRAE HQ Building
Atlanta, Georgia
Three Simple Slides

- The WSHP data Y axis fits BELOW VRF data
- The Peaks
  - VRF is air cooled so peaks in afternoon
  - WSHP do not
- Energy Consumption
  - WSHP efficiency is so high that non-geo WSHP’s would be more efficient than VRF
- Three simple slides follow – available online
The results: WLHP Enhanced Systems vs. VRF
ASHRAE Headquarters in Atlanta

Live Data Available online

May 9, 2012 PEAK

http://images.ashrae.biz/renovation/

GLHP System Dramatically reduces Daily Peak Load
The results:
WLHP Enhanced Systems vs. VRF

ASHRAE Headquarters in Atlanta

Live Data Available online http://images.ashrae.biz/renovation/

January 1, 2012 to May 9, 2012 Energy Use
The results:
WLHP Enhanced Systems vs. VRF

ASHRAE Headquarters in Atlanta  2010 HVAC Energy

GLHP vs. VRF
System Power (kWh)

GSHP = 25.26 kWh / sq. ft. / year
VRF = 39.66 kWh / sq. ft. / year
The Numbers in ATLANTA

39.66 kWh – 25.26 kWh = 14.40/sq. ft./year

WSHP saves 36.3% or VRF costs 57% premium

\[
\frac{14.40}{25.26} = 57\%
\]

Net Energy Solutions

This means non-geothermal would be more energy efficient than VRF and a lot lower installed cost!
WSHP Enhanced

Note – all of these systems are WSHP compared to each other
Hybrid GLHP Systems
Cooling Load is out of balance with the Heating Load
Lincoln Public Schools

GeoExchange demonstrates exceptional response to Part load Conditions with even higher efficiency

Fig. 2.5. Distribution of 1996 heat pump entering water temperatures (EWTs) as recorded by the Maxey EMS. Total hours operation were 8760.
Even More Enhancements

– Hybrids or GeoExchange as a supplement
– Mange first cost to operating cost
  • Cooling tower or dry cooler augment loop - economizer
  • Boiler to eliminate antifreeze – DHW boiler already?
– Controls
  • Onboard basic and communicating
  • Loop control panels
  • Standalone programmable, learning, and zoning
  • BMS – BacNet, Lon – virtual? Web?
  • Self-commissioning
  • Monitoring – even if only the Bill...
– Piping options including LoadMatch GeoExchange
– Heat exchangers, pumping, mass tanks
– Unit mounted accessories from valves to fusing
– The challenge is to identify heat sources and loads and add it to what makes sense within the BUDGET!

Recommended: The development of a simplified user-friendly tenant education guide
A mature Industry provides Help

Multiple Configurations and Models – Horizontal, Vertical, Console, W2W

AHRI certified performance
Geo as far back as the 50’s, growth in the 70’s, closed loop in the 80’s

Software – where do you get data

Ground and Loop Information

Building and Heat Pump Information
Life-Cycle Cost Analysis (LCCA) is a calculation method that adds first cost to 20–25 years of annual energy and maintenance costs, inclusive of equipment replacement costs and an estimate on inflation. The option that has the lowest life-cycle cost is usually chosen if the budget allows.

Simple Payback Period is a calculation method that divides first cost by the annual energy savings to determine how long it will take to break even on the investment.

Return on Investment (ROI) is a calculation that takes the ratio of the energy savings over a predefined number of years minus the first costs divided by the first costs.

Capitalization Rate – How much will my building Earn?
Utility bills are what is referred to as “relevant operating cost” For the “life of” or at the “sale of” the building that cost will effect Net Profit $ and building value
Tools to balance the budget
The lowest possible operating cost for your budget

www.waterfurnace.com

Thank you