**BIG buffer tank for Makeup Air**

- 3,000 gallons
- Allows “dumb” heat pumps to meet varying loads
- Reduces peak load on heat pumps
- Reduces peak load on borehole field
DD Energy Modeling and Optimizing Systems
DD Energy Modeling and Optimizing Systems

Energy Use Intensity (EUI) -- Site Energy

- EIA 2003: 277 KBtu/sq.ft. - yr.
- Code Proctor: 166 KBtu/sq.ft. - yr.
- NZR Proctor: 61 KBtu/sq.ft. - yr.
The George D. Aiken Center at the University of Vermont

- Near Net Zero since 2012
- Renovation
- Biophilia

- SF: 40,000 sf
- Existing Building EUI: 89 kBtu/sf/yr (actual)
- EUI: 31 kBtu/sf/yr (modeled)
- EUI with Renewables: 25 kBtu/sf-yr
- LEED Cert: Platinum

Photo by: Jim Westphalen
Pre-Renovation Wall Conditions
Detail at floor slab
Thermal diagram

Pre-renovation  Post-renovation

Existing Building Envelope  New Building Envelope

-2 F  65F
Integrated design
Daylighting strategy
Window head

- EXTERIOR FINISH
- INSULATION
- STRUCTURE
- INTERIOR FINISH

- AIR & MOISTURE BARRIER, CONTINUOUS
- MOISTURE (WATER) BARRIER

- LOOSE LINTEL ANGLE, SUPPORTING LOOSE STONE LINTEL
- 2X8 WOOD WINDOW BLOCKING
- GYP. WINDOW HEAD RETURN
- WINDOW STRAP
- CAULK & BACKER ROD
- LOW-EXPANDING FOAM

- EXISTING SHEATHING
- NEW EXTERIOR CLASS-MAT-FACED GYP. SHEATHING
- SPRAY-APPLIED AIR AND MOISTURE BARRIER OVER EXTERIOR SHEATHING AND SPRAYED OVER SELF-ADHERING MEMBRANE THROUGH FLASHING
- RIGID INSULATION CUT AT 45 DEG. ANGLE
- MORTAR NET
- SPRAY-APPLIED AIR AND MOISTURE BARRIER OVER FLEX WRAP
- FLEX WRAP, WRAP OVER VINYL ANGLE AND WINDOW PAN
- 2"X5" VINYL ANGLE
- SELF-ADHERING MEMBRANE OVER METAL FLASHING WITH Drip Edge
- ¾" x ¾" WEEP CUT @ 24" O.C.
- DRIP EDGE CUT INTO LINTEL
- ¾" BACKER ROD AND SEALANT TO ALLOW FOR ¾" DIFFERENTIAL MOVEMENT
- ALUMINUM WINDOW PAN
OUTCOME

- Model Net-Zero Renovation
- Out-performing almost all New Construction
- Biophilic Design
NRG Systems

- Near Net Zero since 2004 + 2008
- 75,000 sf Office and Manufacturing
- Thousands of visitors / year

Building One - 2004
- SF: 46,000 sf
- EUI: 18.2 kBtu/sf/yr (actual)
- EUI w/ Renewables: 12.8 kBtu/sf-yr
- LEED Cert: Gold

Building Two - 2008
- SF: 31,000 sf
- EUI: 17.7 kBtu/sf/yr (actual)
- EUI w/ Renewables: 9.4 kBtu/sf-yr
- LEED Cert: Gold
Integrated Environmental Design & Systems
NRG Systems 60 Riggs Rd
Estimated Annual Energy Cost
Compared to Code and Typical Buildings**

$120,000
$100,000
$80,000
$60,000
$40,000
$20,000
$0

First Year Energy Cost

Typical existing metal building*
Typical custom new building
NRG before renewables
NRG after renewables

* Based on energy usage of similar sized existing facility, rough estimate
** Based on computer modeling of building performance and estimates of renewables contribution
*** Propane at $2.50/gallon, pellets at $250/ton, electricity at Avg $0.14/kWh
**** Purchased non-renewable fuel (propane and grid electricity - PV’s estimated to provide 90% of electricity, pellets 95% of thermal)
NRG - Predicted vs Actual Jul 05 - Jun 06
Total kWh, Thermal Btu, Lighting kWh, Misc kWh
Energy Conservation