

A Brief Summary of the Schools and Technologies we reviewed or visited during May 24th & 26th Tours - compared to Current Conditions at HUES and HP.

Plainfield Elementary School – Plainfield NH - Retrofit

Before:

- 35,000 square feet
- Oil Heat – 21,000 gallons/yr.
- Electric Usage – 215,000 kwh/yr

Improvements:

- Shell – Walls, foundation, roof, and windows
- Heat Source – Air source heat pumps (ASHP) & Propane for Gym
- Ventilation – Energy Recovery Ventilation (ERV)

Results After:

- Propane usage 4,500 gallons/yr. to heat gymnasium this is the equivalent of 3,000 gals of oil
- Electricity for lights, plug load, and heating 165,000 kwh/yr – heating costs now equal the cost of lighting each room
- Total energy savings for entire school now is two thirds less than when they started.

Important Lessons:

- Shell improvements made ASHP possible.
- Significant improvement in Teaching Environment through Comfort:
 - stability of heating,
 - provided cooling,
 - improved relative humidity,
 - greatly improved ventilation with CO2 controlled ERVs
 - reduced ambient noise

Mascenic School District, Host: Gary Somero, Facilities Director

Boynton Middle School - Retrofit

- 75,000, SF
- Oil Heat Before converted to wood pellet
 - Boiler replacement
 - Uses 70 to 90 tons of pellets/yr.

Improvements:

- Shell – Newer building only 30 years old no improvements needed
- Heat Source – Pellet Boiler
- Ventilation – Existing Heat Recovery Ventilation (HRV)

Highbridge Hill Elementary School – Retrofit

- 75,000, SF
- Runs off of High School boiler – only a heat exchanger in the building
 - Boiler replacement cost shared with High School
- Solar Hot Water Thermal Collector
 - Covers all hot water in the summer
 - Supplements during the winter
 - 160° F Water cooled down to 120° F for use in school

High School, New Ipswich - Retrofit

- 86,000 SF
- Automotive Learning Center 18,000 SF
- Oil Heat Before
- Converted to wood pellet Solagen 3,500,000 mmbtu which serves entire three building campus with 1500' of district energy piping
 - This boiler heats the High School, the Highbridge Hill Elementary School and the Automotive Training facility which we did not visit for a total of 179,000 SF.
 - Boiler replacement and district energy system
 - Uses 210 tons of pellets/yr.

High Mowing School, Wilton - Retrofit Host: Mark Froling, Froling Energy

- 77,862, SF
- Oil Heat Before converted to dry wood chips 2 Froling Boilers 1,023,600 mmbtu (300 kw) & propane backup
 - Entire project included Boiler, fuel handling, heat storage, back up propane boilers, district piping, controls and heat exchangers in each building.
 - Uses 355 tons of dry chips/yr. for this past year (80% wood 20% propane), previous year much colder.
 - Residential School has very high domestic hot water (DHW) use for dorms and kitchen using about 15 tons of dry chips a month just for DHW.
 - Set up as a 20 year Power Purchase Agreement
 - This appears to have been a good deal for the school as their heating bill stayed about the same and all the capital costs of the installation are covered by the 20 year agreement. They also have greater comfort, much less maintenance as a result of not owning the plant, and they meet the schools sustainability goals.
 - All in all this is a fairly unusual situation compared to a public day school.

Sanborn Regional School District,

Hosts: Steve Riley, SRSD Facilities Director and Mick Dunn, Shift NRG

Memorial Elementary School, Kingston - Renovation

Before:

- 50,000 square feet
- Oil Heat – 25,000 gallons/yr.
- Electric Usage after about 54,000 kwh/yr

Improvements:

- Shell – Newer building only 30 years old no improvements needed
- Heat Source – Air Source Heat Pumps with individual room controls
- Ventilation – New Energy Recovery Ventilation (ERV) in each room
- Old oil heat system maintained as backup did not run last year during warm winter, ran only a few days in previous cold winter
- Solar Thermal Wall used to heat Gymnasium and use as preheat to Gym Air Handler.
- **Phase Change Materials (PCM) were used in an adjacent building which we did not visit.**
 - PCM was installed above hung ceiling.
 - If PCM is used at the time of overall project installation they help reduce the room demand and all for smaller ASHP's to be installed
 - In which case the reduced cost for the ASHPs helps to cover the cost of the PCMs.

Important Lessons:

- Shell was good enough to make ASHP possible.
- By reducing the heat demand or load a project can reduce the size and cost of its initial capital expenditure (CAPEX) for which ever heat source is chosen.
- By maintaining existing oil system as back up heat pumps can be designed for less than 100% of peak load again saving on initial capital expenditure (CAPEX).
 - The oil backup system did not run at all this past winter which was a mild winter.
 - The previous winter, which was a cold one, it ran only a few days.
- Significant improvement in Teaching Environment through Comfort:
 - stability of heating, (eliminated 20° F temperature swings)
 - provided cooling,
 - improved relative humidity,
 - greatly improved ventilation with centrally controlled ERVs
 - reduced ambient noise

Second Nature Academy, Nashua - All New Construction

Host Dennis and Debby Gleason, Skillings & Sons and KW Management

- 4,800 square feet
- Excellent Shell – R-40 Walls, R-20 Foundation, R-60 Roof, Triple Glazed windows. These numbers are similar to the Plainfield School retrofit.
- Ground Source Heat Pump (GSHP) –
 - Water source heat pumps have a Coefficient of performance (COP) of more than 5 (this means for every unit of electricity the system uses the building receives 5 units of heat)
 - Tiny efficient variable speed motors run the continuous loop flow of water from the well to the heat exchanger.
 - Storage tank to accommodate variable demand in building
 - Also covers domestic hot water
- Electric Usage – 60% provided by photo voltaic panels (PV).
- PV panels 10 KW
- Larger building not quite so efficient but still run on GSHPs but no PV due to shading by trees.
- Shell and air exchange also excellent but not quite as efficient as the first building

Hollis Primary School - Current Conditions

- 46,918 square feet
- Oil Heat 3 year average - 18,000 gallons/yr.
- Electric Usage 3 yr. average - 261,000 kwh/yr

Hollis Upper Elementary School – Current Conditions

- 96,528 square feet
- Oil Heat – 22,000 gallons/yr.
- Electric Usage after about 509,000 kwh/yr

Prepared by Dick Henry based on information collected from two field trips on May 24 and 26, 2016