

# HVAC Options Analysis for Town Hall



## The options studied

- Option #1 - Oil system
- Option #2 - Geothermal

- Why do we need to overhaul the heating system and spend money?

# Symptoms

- Time consuming and expensive to maintain
- Less efficient than it could be
- Uneven heating and cooling
- Low air quality

# Engineering company – provided two studies



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---New York Construction, "Project of the Year"

*"We rely on CES for timely and accurate design services that meet our changing needs. The [members of the] CES team are diligent in their efforts to finding energy conscious design solutions that will serve our facilities for years to come."*  
---Connecticut General Assembly, State Capitol

## **Recommendation from Consulting Engineering Services, Middletown CT – December 2007**

The building was renovated in 1984 and the HVAC system was replaced at that time. Most of the equipment is original to that renovation and appeared to be reasonable well maintained and in fair condition, but approaching the end of their useful lives.

We would recommend the following system modifications to address the issues stated above:

1. Replace all of the heat pump units, ductwork, grilles and thermostats because of their age and condition. Additionally, the building floor plan has had enough changes over the years that the ductwork system and thermostat placement no longer makes sense.
2. Repair or replace the cooling tower. The upper section of the cooling tower was replaced approximately 4 years ago and the lower section now needs replacing. A new cooling tower with additional capacity should be considered to accommodate the increased ventilation required under the current building code.
3. Replace the boilers, pumps, piping and controls in the boiler room and relocate the equipment well above the high water level of the boiler room because of occasional flooding.

# System components

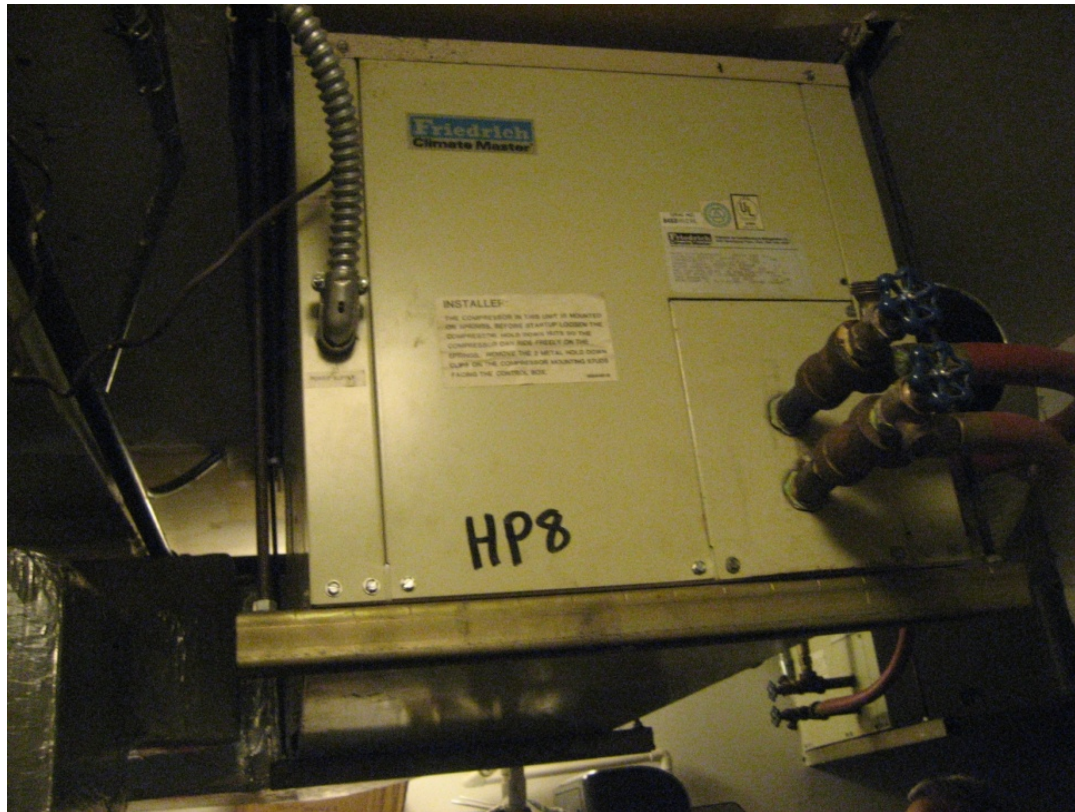
Save, Replace or Eliminate?

# Oil Boilers – Replace or Eliminate





# 19 Heat Pumps - Replace



# Ductwork - Replace



# Ductwork difficulties

- ....Issues with fiberboard ductwork have surfaced in the past 25 years.
- This type of ductwork is used less frequently today because of potential mold and bacteria growth within the ductwork.
- Internal deterioration over time which releases glass fibers into the airstream, and it is very difficult to clean without damaging.

# Ductwork difficulties

- In certain cases, where there is not enough ceiling space for ductwork, the exterior walls have been built out to have a cavity between the masonry wall and the framed wall.
- This cavity is used as a supply air plenum with windowsill supply grilles installed at each window on the wall.
- The issue with this installation is that the wall cavity is not insulated, so much of the energy in the heated or cooled air is transferred to the outside wall before reaching the supply grille and entering the room.



# Cooling Tower – Replace or Eliminate



# Existing Building Loop – Save!

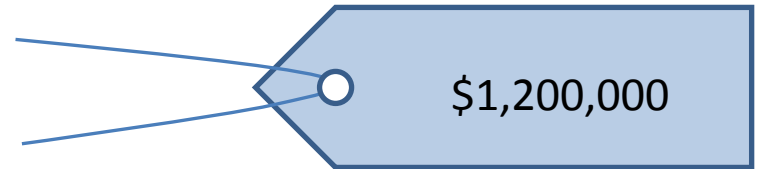


# Requirements

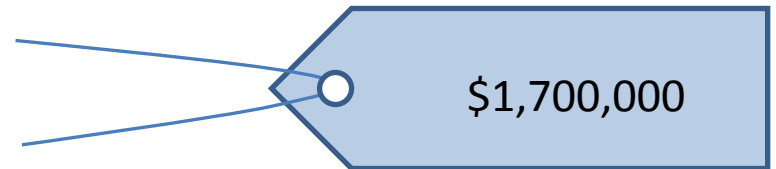
- Both option #1 and option #2 require:
  - replacement of :
    - Heat Pumps
    - Circulator Pumps (change to variable speed)
    - Ductwork and grilles (eliminate fiberglass)
    - Controls (programmable T-stats, pump controls)
    - **Add fresh air exchange**

# Cost comparison

- Option #1 – Oil replacement system



- Option #2 – Geothermal System





# Why the cost difference?

Elimination of:

- Oil Boilers

- Cooling tower

Add the installation of ground heat exchanger

- 60 wells under parking lot and piping to building

- 450 ft deep

- 20 ft apart

# Save, Replace or Eliminate?

	Save	Replace	Eliminate
Option #1	Water Loop	Heat distribution components, oil boilers, cooling tower	nothing
Option #2	Water Loop	Heat distribution components	oil boilers, cooling tower

# Operating Costs

	Annual Consumption		Annual Cost
	Electricity (kWh)	Oil (gal)	
Current	333660	9,126	\$88,883
Option #1	242030	13,315	\$81,216
Option #2	232130	0	\$45,961

# Which option is best?

Things to consider:

- Initial cost
- **Operation Cost**
- Payback period
- Oil dependence

# Another reason

Article for the *Tolland Monthly* March, 2009

## Understanding Climate Change

There is a lot of talk about climate change, in media and in government, and a majority of Americans now consider the topic a major concern. Despite this concern, many thoughtful people continue to believe that we should wait before making substantial changes to our energy and economic systems. In this article we will present a few ideas to help navigate this complex problem.

According to the 2007 assessment of scientific literature conducted by an international body of scientists (the Intergovernmental Panel on Climate Change – IPCC, see <http://www.ipcc.ch/ipccreports/assessments-reports.htm>), atmospheric concentrations of Greenhouse Gases (carbon dioxide, methane, nitrous oxide which are byproducts of burning coal, petroleum, and natural gas) continue to increase exponentially. In addition, observations of temperature, tropical glaciers, sea ice, ocean heat content and sea level, all show an unequivocal warming throughout the climate system. Further evidence from theory and numerical climate models suggests that the warming of the climate system, which has been observed, is very likely linked (with 90% certainty) to the increasing atmospheric greenhouse gas concentrations. Projections of climate through the next hundred years show large, destabilizing changes in the climate system given continued growth in the use of fossil fuels.

We are putting a lot of CO<sub>2</sub> into the atmosphere and in response the climate is warming. But the discussion is always about what might happen in one hundred years. Do we need to worry about it now, especially when the global economy is in a meltdown? This question of urgency is *the* question of the moment, and one that has at least three causes for concern.

Let's imagine earth's atmosphere is a bathtub, and the concentration of CO<sub>2</sub> is the level of water in the tub. The faucet (emissions of CO<sub>2</sub>) is opening more with each year and the drain is removing only 40% of what is coming in, so the level in the tub continues to increase. To keep the level from increasing further (stabilize CO<sub>2</sub>), the faucet would have to close (reduce CO<sub>2</sub> emissions) by 60%! This is our first real problem. We need to turn down the faucet by 60% just to stop the level from increasing, but currently the faucet continues to open.

# Life Cycle Cost Analysis

- Most significant variable is fuel costs
- Trends are hard to predict
- How significant are the savings in operational costs compared to increase in initial investment?

	Initial Investment	Annual Operating Cost
Option #1	\$1,200,000	\$81,216
Option #2	\$1,700,000	\$45,961

# Payback period depends on fuel cost

# Scenario One

- Energy Costs:
  - Oil = \$2.50/gallon
  - Electricity = \$0.198/kWh

	Simple Payback (years)	
Option #1	271.7	
Option #2	20.9	



# Scenario Two

- Energy Costs 50% increase:
  - Oil = \$3.75/gallon
  - Electricity = \$0.297/kWh

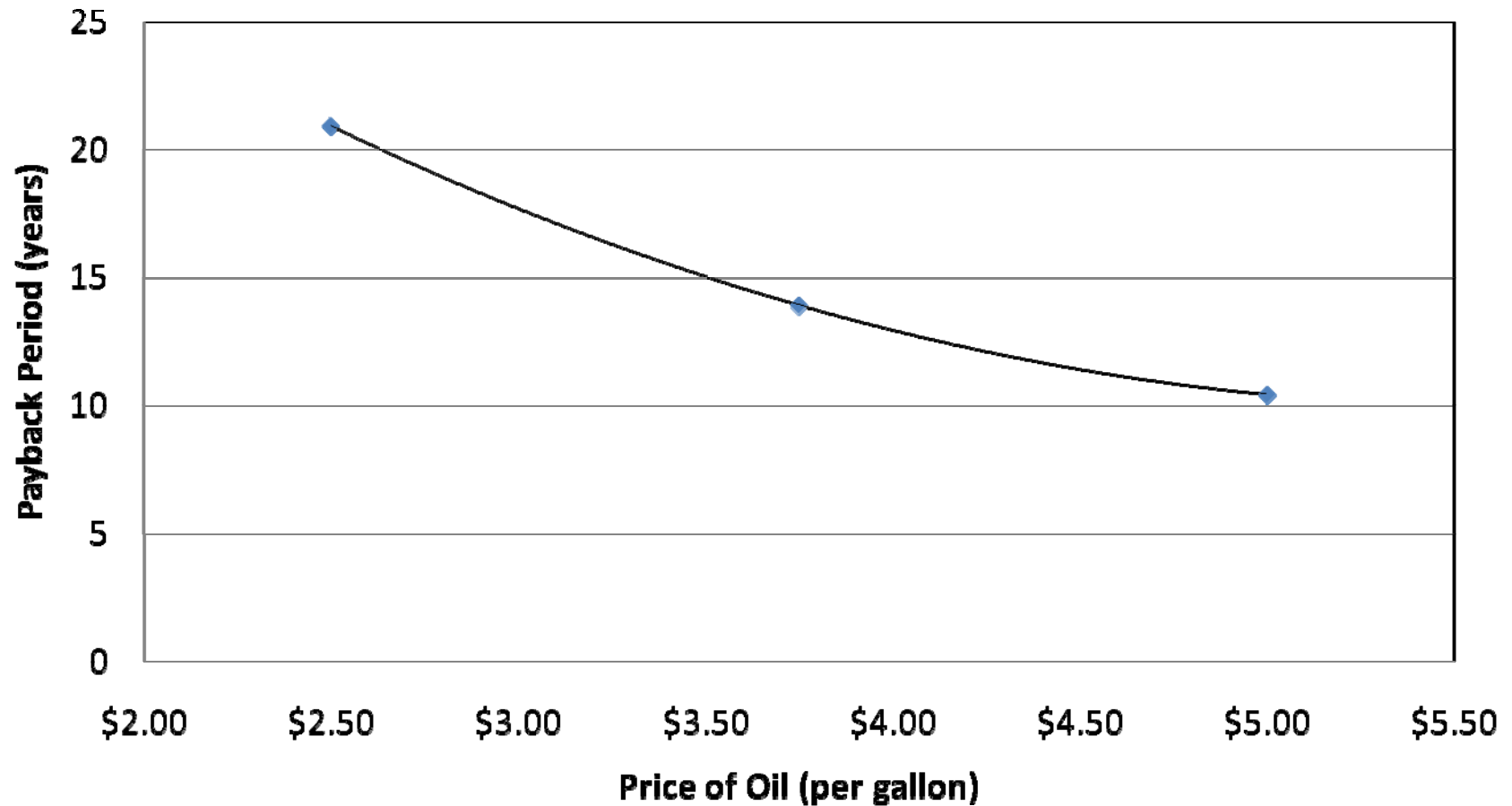
	Simple Payback (years)	
Option #1	181.1	
Option #2	13.9	

# Scenario Three

- Energy Costs 100% Increase:
  - Oil = \$5.00/gallon
  - Electricity = \$0.396/kWh

	Simple Payback (years)	
Option #1	135.8	
Option #2	10.4	

# Impact of Oil Price on Geothermal Payback Period



# Additional project costs

	Option #1	Option #2
HVAC Systems Cost	\$1,200,000	\$1,700,000
Carpet/Lights/Ceiling	\$100,000	\$100,000
Parking Lot Repave	\$0	\$35,000
Subtotal	\$1,300,000	\$1,835,000
10% Design Professional	\$130,000	\$183,500
Commissioning	\$50,000	\$50,000
Subtotal	\$1,480,000	\$2,018,500
Interest (20yr/3.25%)	\$555,855	\$758,104
Total Project Cost	\$2,035,855	\$2,776,604

# Oil versus Geothermal

## Oil (option #1)

- Less expensive to retrofit
- Less disruption

## Geothermal (option #2)

- Uses less energy
- Less pollution
- Uses electricity only
- Cleaner air
- Fewer devices (less maintenance)
- Faster payback
- More control
- Tone

# TETF Recommendation – Option #2

- Geothermal

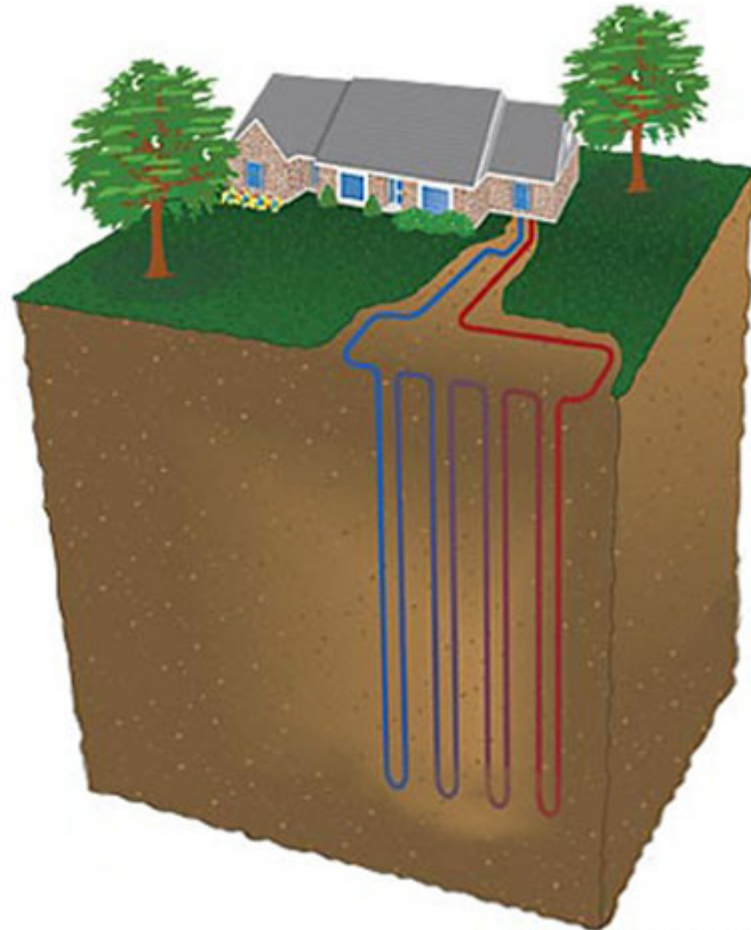


Image courtesy of ClimateMaster

# Future steps

- Buy in from the town leaders
- Thermal conductivity test for one test well
- Building thermal scan
- Funding

- Thank you for your consideration