

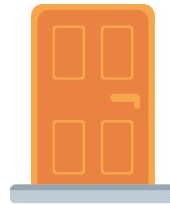
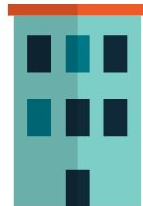


SSAFE Greening Our Campuses Presentation

The Energy Audit - Step One on the Path to Net Zero

By Stu White, Kendal at Hanover

Originally presented at the SSAFE Energy Audit Working Group on March 7th, 2022



Review of March 7 March 7 Presentation: The Energy Audit

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April 4, 2022

Components of a Professional Energy Audit

1. Hold a kick-off “charrette” meeting and follow up with comfort survey
2. Quantify on-site usage of fossil fuels and electricity
3. Take deep dive into all past design documents, historical energy data
4. Determine our “miles per gallon” equivalent
5. Identify opportunities for significant savings
6. Model facility with energy modeling software
7. **Determine best options for all-electric operation**
8. Examine potential for on-site renewables (solar)
9. Perform Financial analysis: life cycle cost and return on investment
10. Deliverables: Final report, e files and hard copies

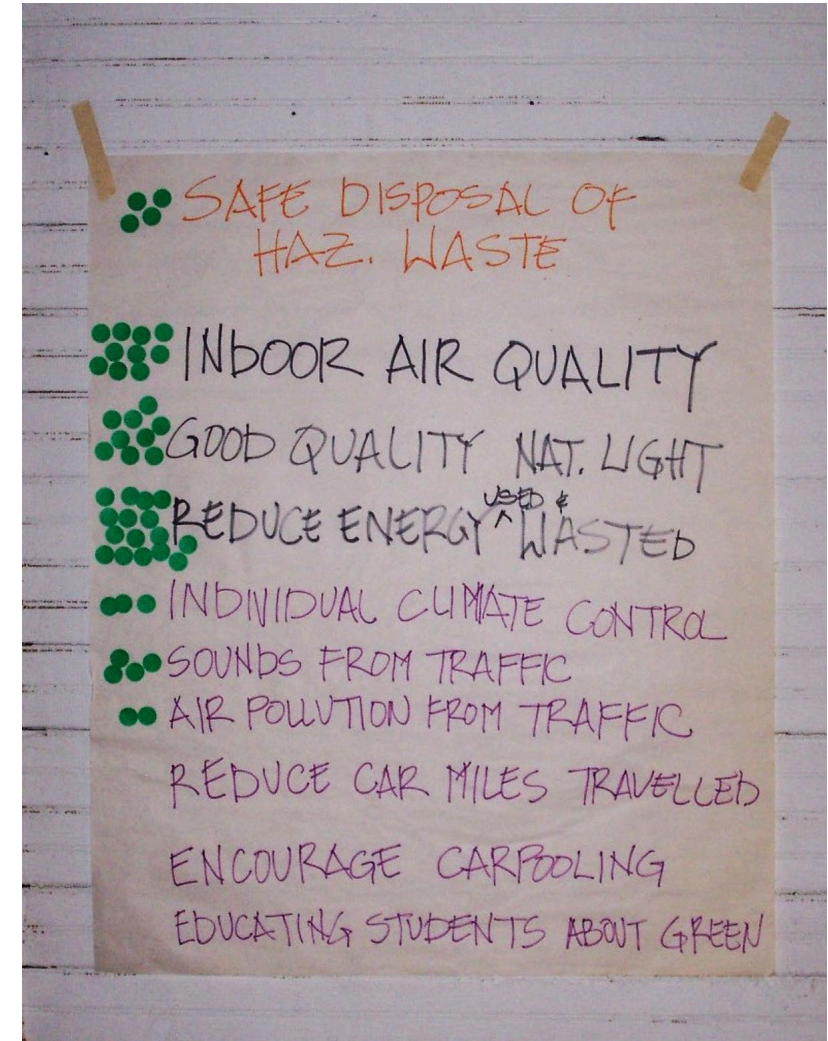
1. Hold a kick-off “charrette” for all residents—follow up with comfort survey



Figure 1. Charrettes provide a space for people to work together to solve divisive issues and create successful projects. Photo courtesy NCI.

Typical resident concerns:

- Why do you have to run the h.w. so long to get h.w.?
- Why are these lights on all the time?
- Why aren't these L.E.D. bulbs?
- Why is my apartment so hot when it's 0 deg F outside?
- What about ice on roofs?



2. Quantify on-site use of fossil fuels and electricity

3. Deep dive into all past design & const. documents, historical energy data



**Energy consumption at KaH buildings 2001-2019
in kilowatt hours (KWH) and gallons of propane**



- As built drawings & specs
- Contractor submittals
- Previous diagnostic test results (if any)

4. Determine our Miles per Gallon Equivalent

8-10-20

KENDAL KBtus/sf/yr.

CONV. KW → BTUS: 1 KW = 3,412 BTUS
 PROPANE → BTUS: 1 GAL. PROPANE = 91,502 BTUS

	2019	2018	2017	3YR TOTAL	3YR AVG
KWH	4,914,000	5,584,640	5,270,300	15,768,940 ÷ 3	5,256,313 KWH
GALS PROP.	318,622	314,837	281,038	914,497	304,832 GAS PROP.

KWH → BTUS = 5,256,313 × 3,412 = 17,934,539,956 BTUS
 PROP → BTUS = 304,832 × 91,502 = 27,892,737,664

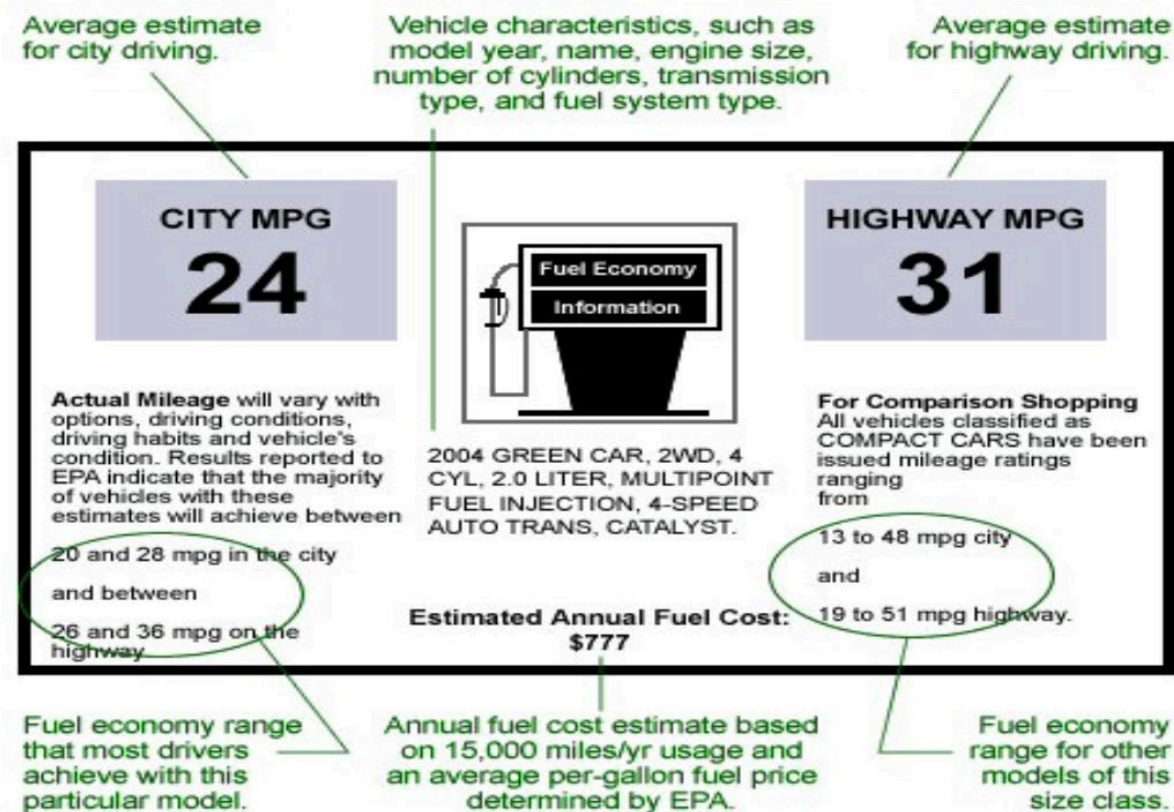
TOTAL BTUS 45,827,277,620

TOT. BTUS → $\frac{45,827,277,620}{575,000 \text{ SF}}$ = 79,700 BTU/SF/YR OR EUI = 80

← ENERGY USE INTENSITY
 kBtus/sf/yr

4. Determine our Miles Per Gallon equivalent...

Will Your Building Come With A Sticker?



4. MPG (cont.)... and establish a BENCHMARK

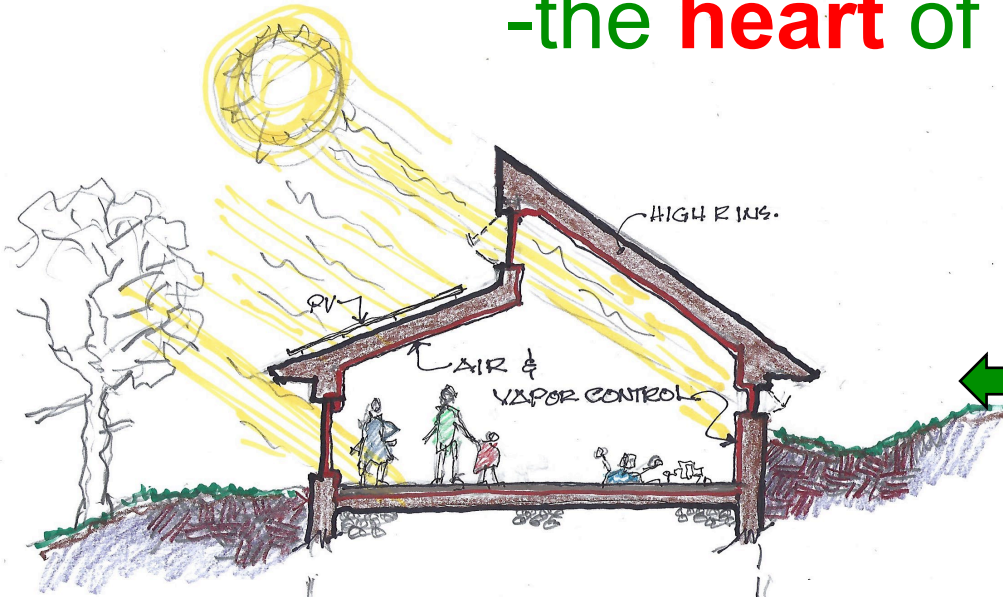
chart from EPA / Architecture 2030

Restaurant / Cafeteria		612	53%	302	151.0	120.8	90.6	60.4
Health Care: Inpatient (Specialty Hospitals, Excluding Children's)		468	47%	227	113.5	90.8	68.1	45.4
Hospital (Acute Care, Children's)	✓				50% by 2030			
Health Care: Long Term Care (Nursing Home / Assisted Living)		225	54%	124	62.0	49.6	37.2	24.8
Health Care: Outpatient		183	72%	73	36.5	29.2	21.9	14.6
Clinic / Other Outpatient Health		219	76%	84	42.0	33.6	25.2	16.8

“**Benchmarking** is the practice of comparing the measured performance of a facility to itself, its peers, or established norms, with the goal of informing and motivating performance improvement.” -DOE

(“You can’t manage what you can’t measure!”)

5. Identify opportunities for significant savings -the **heart** of the audit



TASK FOR AUDIT: *test existing buildings to establish base case air tightness value; locate problems; recommend Energy Efficiency Measures (EEMs)*

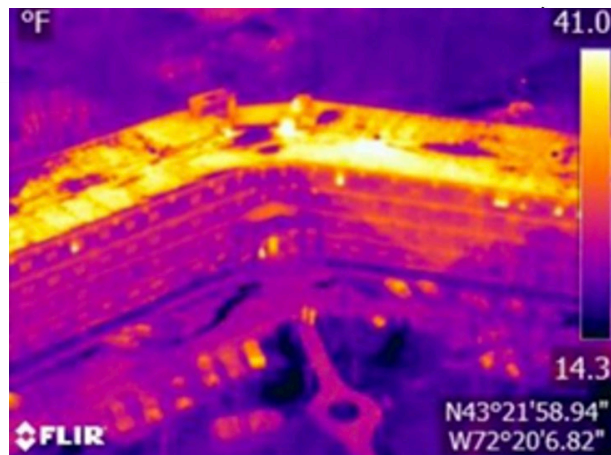
A HIGH PERFORMANCE BUILDING ENVELOPE WILL:

- allow dramatic reductions (target **50% +**) in energy consumption
- lower costs for electrification and renewables

Apply Building Science with Diagnostic Testing...



Blower Door



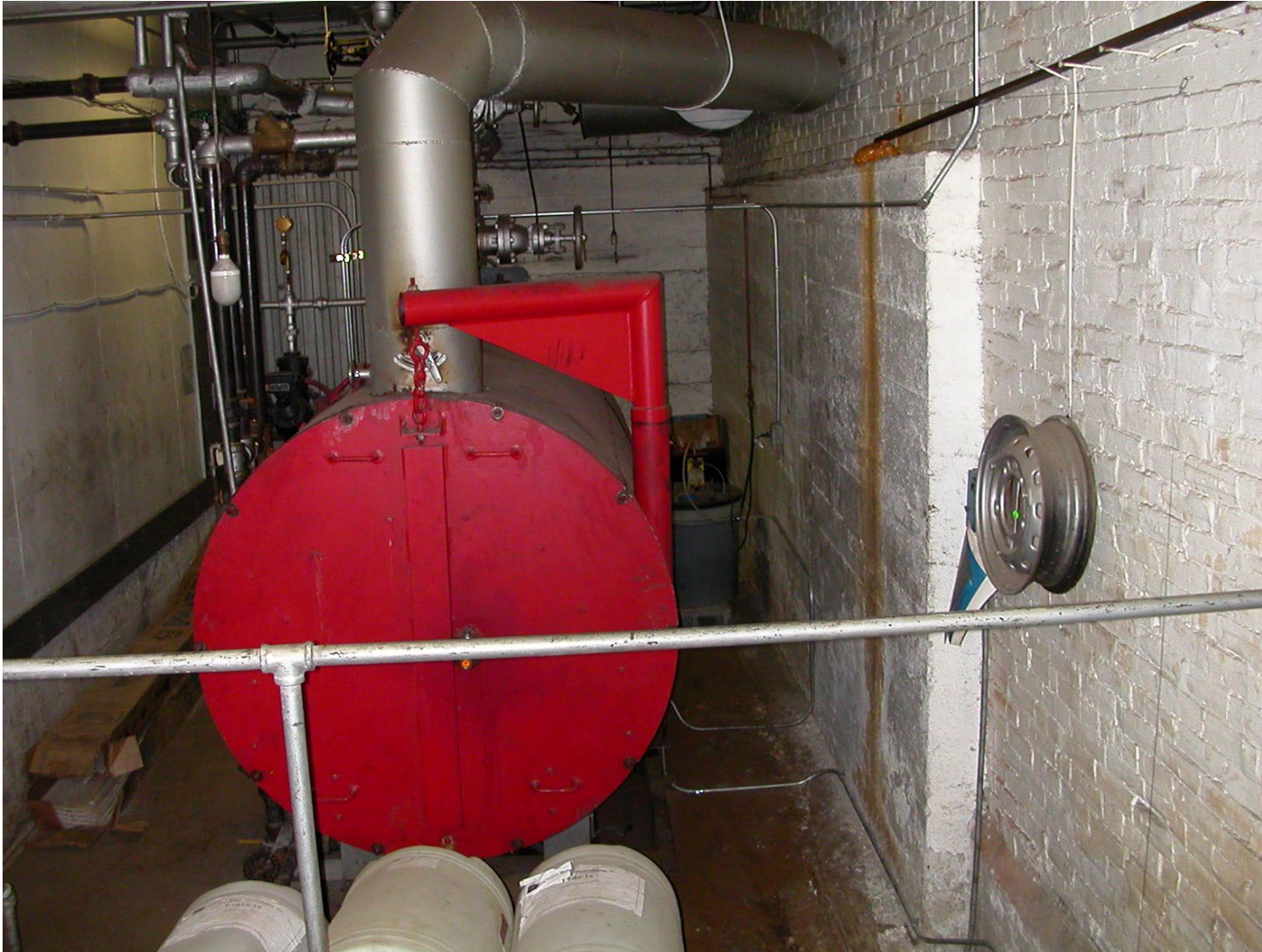
infrared camera thermography



Deep Energy Retrofits =
50% + energy reduction



5. Identify Energy Savings (*cont.*)



- Analyze **HVAC** and **electrical** systems
- Identify weakness
- Recommend Energy Efficiency Measures

6. Model facility with energy modeling software



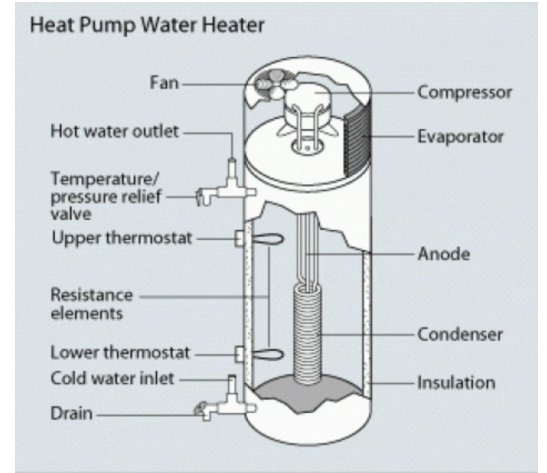
Model	EUI
BASE: existing building envelope R values and measured performance, fuel consumption – all sources, thermal and electrical	47.55

RECOMMENDATIONS

GENERAL:	
<i>High priority: radiant heating and cooling throughout with localized control</i>	
WEEKS envelope upgrade: along with scheduled re-roofing project: air sealing, increase R value at entire envelope, misc. mechanical upgrades	44.24
WORKROOM ('PIT') Remodel offices, replace some glazing with high R wall, repair exist. radiation connections or furnish new	43.93
CONFERENCE Add heat & AC, improve envelope (air sealing and R value)	45.68
WINDOWS/GLASS Replacement: all South/SE/SW	39.19
MAIN (1980) Air sealing, upgrade passive/hybrid system for thermal storage in building mass, cooling coils in water tubes for radiant AC	35.01
FRENCH Little to no work	
ELECTRICAL Upgrades: Motors, lights, Daylight controls	31.44
ADD AC throughout	33.08
CHIPS to PELLETS Increase in eff. From 60%-80%	27.82
TARGET	28

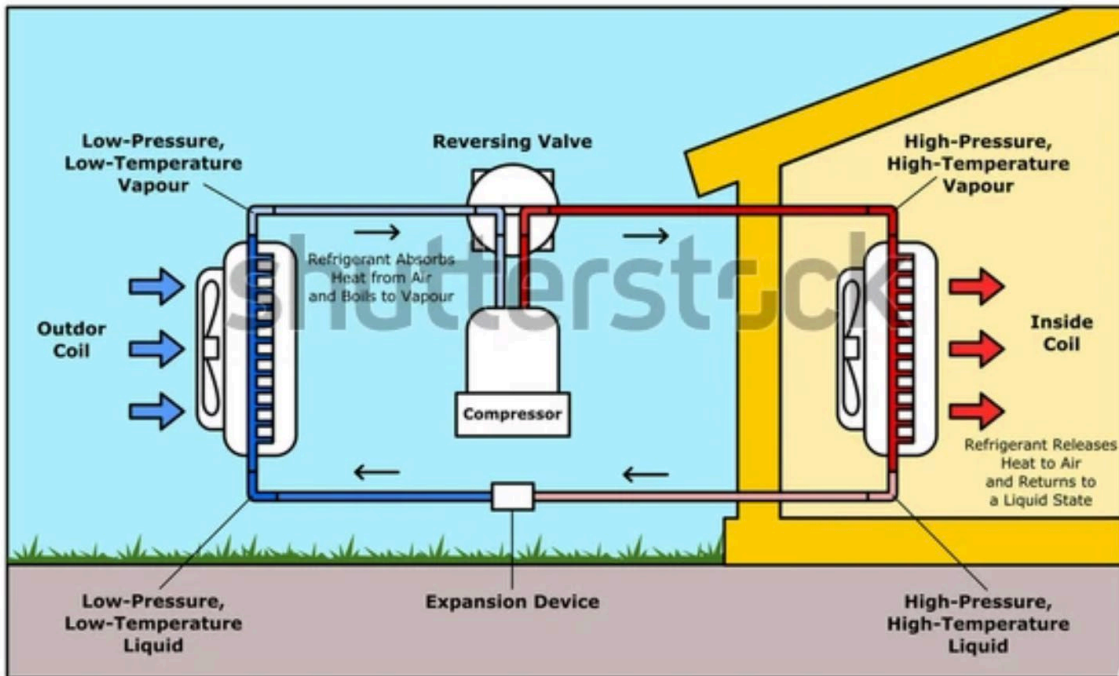
Engage in iterative energy modeling...to understand the interactive effects of various design decisions and to assess progress towards meeting the EUI target. –*Architecture 2030*

7. Determine best options for all-electric operation

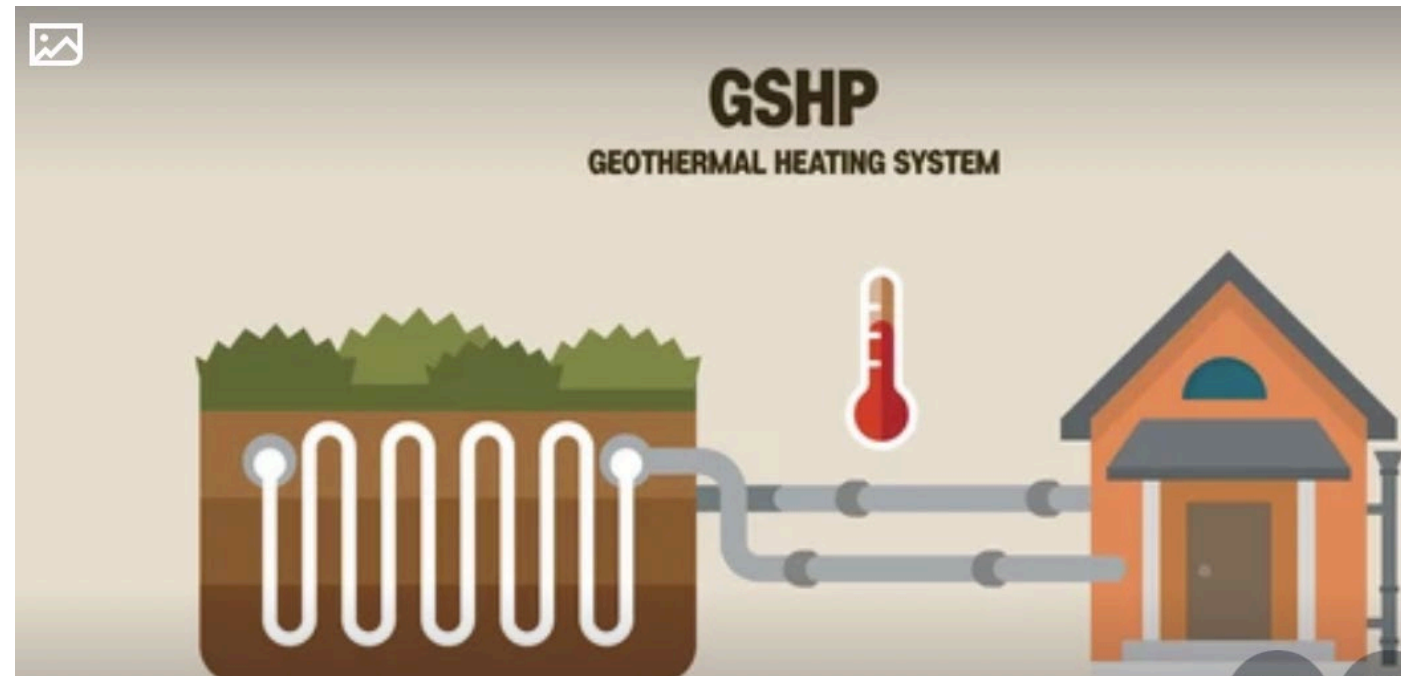


Heat Pump HW Heater

Air Source Heat Pumps Heating Cycle



Ground Source Heat Pumps



8. Examine potential for on-site renewables (solar)

Check out google earth – light colored roofs = potential



Kendal at Lexington



Kendal at Hanover

9. Perform cost review: **Life Cycle Cost Analysis (LCCA)**

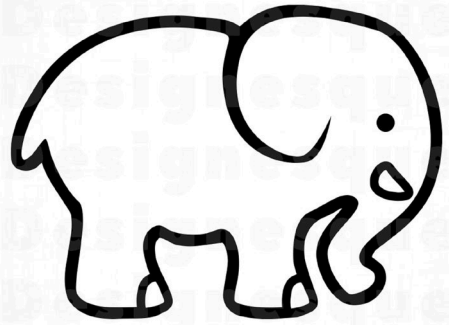
-**R**eturn **o**n **I**nvestment, **S**avings to **I**nvestment **R**ation, **N**et **P**resent **V**alue

- When reviewing individual Energy Efficiency Measures for **payback** it is important to keep in mind the interactive effects of various decisions:
 - While one measure may appear to have an extended payback by itself it may be key to the success of the project and may need to be retained; **eg, building envelope upgrade**

10. Deliverables:

- e files available to all, 2 hard copies
- Public presentation to entire community, in person and on Zoom
 - Provide a good “bookend” to opening charrette, engage residents and staff

FOR FUTURE DISCUSSION, NOT PART OF AUDIT SCOPE:



In the room: \$ \$ \$ \$ \$ \$ \$ \$

How can we ever afford a net zero campus?

FINANCING OPTIONS—there are many

THERE ARE WAYS TO DO THIS!!

THIS IS NOT THE TIME TO THINK SMALL

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