Town of Chevy Chase Climate & Environment Committee
Home HVAC Primer
December 2021

Background

This primer was created to provide information to Town of Chevy Chase residents who want to switch their home heating, ventilation and air conditioning (HVAC) systems to more environmentally-friendly systems. The purpose of this guide is to provide a quick primer for common scenarios and to help residents get started thinking about home systems which help save the most money and reduce fossil fuel use. Each home situation can be fairly unique so this isn't meant as a complete guide, but rather idea-sharing on things to consider when looking to switch or upgrade home HVAC systems.

Initial Questions:

- Is this a retrofit situation or new home/major renovation?
- If retrofit, what are the current heating and A/C unit(s), and what is the current HVAC delivery system (radiant floor heating, radiators, steam or hot water, ductwork, location of ducts. whole house or zones or single rooms, for both AC and for heating)?
- If retrofit, what is the vintage, condition and likely remaining useful life of the current heating and A/C units?
- If either a new home or a major renovation, is the property suitable for a ground-source (aka geo-thermal) heat pump system?
- How does the homeowner value carbon emissions vs. operating cost vs. capital cost vs. comfort?
- What are the homeowners' preferences regarding the levels and schedules for both heating and cooling?
- What scenarios does one want to assume regarding future electricity and gas prices?

Despite the variability in advice that would stem from issues like the questions above, here are a few generalizations to consider:

- If a new system for the entire home is under serious consideration and the property is suitable for it, a ground-source (geo-thermal) heat pump system is likely to be a good answer. Here's a link about these, for some basics. https://www.energy.gov/eere/geothermal/geothermal-heat-pumps
- If the area needing cooling is short of the whole house and can be broken into blocks of 1-2 rooms, then minisplit heat pump units will be a better choice than either room A/C units or central A/C or heat pumps. Small, electric radiated heat units can be used for small areas where heating only is needed.
- If you need to buy a new central A/C unit, a heat pump costs only a little more and can assist with heating as well as provide all the A/C.

- In terms of comfort, most people substantially prefer a radiant heating system (e.g. a boiler+radiators) over forced air (e.g. furnace with ducting and forced air heat). That said, a heat pump system can be a more environmentally-friendly solution, potentially combined with an existing radiated heat system. (see next point)
- However, one should not rely on a heat pump for most or all of one's heating needs. At temperatures below about 35 degrees, a heat pump can't provide enough heat and the supplemental electric resistance heater included with most heat pumps will have to do virtually all the work, and they are very inefficient (even worse than electric baseboard heating). At temperatures between roughly 35 and 50 degrees, the heat pump is not very efficient and provides less warm, comfortable air compared with a gas boiler or furnace. If a home has both a heat pump and a furnace or boiler, the best advice may be to have the heat pump set to heat only during "shoulder season", when temperatures rarely get below 50 or so. When you are at a point in the year when temperatures are often below 50 or so, it can be best to turn the heat pump off heat and rely exclusively on your boiler or furnace. You would probably want to rely on a heat pump for heat more than this if your main heating system is an oil burner or all baseboard electric. There are also systems available to automatically convert usage between your heat pump vs. boiler or other alternative heating system.
- Sizing a replacement HVAC unit -- either an A/C unit or a heat pump -- often gets much less attention than it deserves. Most installers will simply replace the old unit with a new one of the same size. Very often, though, the home's heating or cooling load has changed over what's often a couple of decades since the calculations were originally done to size the first unit installed. Often the home has been made much tighter, or perhaps the home is more or less shaded than it was previously. If the homeowner is considering the serious capital investment inherent in a new replacement HVAC unit, then it will likely be worth having the load calculations redone and unit sizing reconsidered. Most installers, if they even think about perhaps resizing, will do a shortcut, limited load calculation rather than the real thing.
- As recently as 25 years ago, virtually all central A/C and heat pump units were single speed compressors and fans. Now most fans/air handlers have at least two speeds, and many compressors are dual speed or even variable speed. Efficiency increases significantly if compressor speed, and to a lesser degree fan speed, can be varied to fit the heating or cooling need at any point in time. In general, though, with the relatively low electricity prices we've had, the payback period for purchase of a higher efficiency unit with dual or variable speeds is too long to justify it. But, this can change if the utility offers some rebate or cost-share for high efficiency units. And, there is a large benefit in terms of cooling comfort from having a variable speed compressor and fan. Running the high efficiency unit relatively constantly and thus obtaining relatively constant dehumidification -- in contrast to a single-speed unit that cycles often from off to on -- significantly improves comfort at a given temperature. In our humid summer weather, a variable speed A/C unit or heat pump can be set at roughly 3 to 5 degrees warmer than a single-speed unit and achieve equivalent comfort. This comfortable higher set point for a variable speed unit is typically not considered in efficiency and payback calculations.

- A/C units and heat pumps can differ widely in their noise output, and noise output may or may not correlate with the unit's efficiency. Noise differences can sometimes be an important factor in choosing a replacement unit, depending on such things as whether the unit is close to outdoor spaces that people frequent (e.g., under the homeowner's deck or next to a neighbor's patio) and/or close to windows that are often left open, etc.
- Oil burners are very high on the list of heat sources that one would want to replace. They are typically older, lower efficiency, require frequent maintenance, require an oil tank that probably takes up useful space and be prone to leaks, and is subject to what seem likely to be rapidly increasing fuel costs.
- Ductwork must be considered when doing a conversion or upgrade. In a new build, ducting would be designed by an engineer to optimize duct placement for heating and cooling efficiency. If you're doing a retrofit on a home that has no ducting, some similar engineering plan will be needed as part of the implementation and whether the ducts will be used for both heating and cooling or just cooling will have to be taken into consideration. Placement of both supply and return air ducts need to be considered in order to optimize your installation.

Looking for cost savings options?

Here are some links that might be useful if you're looking for cost savings options that might be available to you, depending on your situation/equipment and rebates available at the time your project would be underway. Information is available here for both HVAC and water heater solutions.

https://bgesmartenergy.com/residential/rebates-and-discounts/heat-pump-water-heater

https://homeenergysavings.pepco.com/appliance-rebate-program/overview/electric-heat-pump-water-heater

https://energysavemd-home.com/appliance/water-heater-rebates/

https://energysavemd-home.com/appliance/

https://homeenergysavings.pepco.com/appliance-rebate-program

https://bgesmartenergy.com/residential/rebates-and-discounts