

A New Heating System

A homeowner wants to replace their old heating system. Energy is measured in kilowatt-hours (kWh). It takes about 11,700 kWh of energy to heat the house for the winter. The current heating system uses natural gas and is 60% efficient, which means that for every 100 kWh of natural gas it uses, it produces 60 kWh of heat. With the homeowner's current system, it costs \$975 to heat the house.

Research at least two other options available in your area that this homeowner could replace their heating system with. Assume that natural gas costs \$0.05/kWh and electricity costs \$0.21/kWh. The house is 2,500 square feet.

The homeowner also has an air conditioner that uses 2,500 kWh of electricity per year and produces 290 kWh of cooling for every 100 kWh it uses. They also have a water heater that uses 4,300 kWh of electricity per year and produces 90 kWh of heat for every 100 kWh it uses. These systems could also be replaced if there is a cheaper option, but it isn't necessary.

1. Which system would you recommend? Make a graph to convince the homeowner to switch to this system.
2. If the homeowner switches to the system you recommend, how long will it take them to save as much money as the new system cost?

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Here are three other types of heating systems the homeowner could replace their current system with:

- A new furnace which also runs on natural gas and is more efficient. For every 100 kWh of natural gas it uses, it produces 95 kWh of heat. This system costs \$5,000 to install.
- A geothermal heat pump. This system uses electricity instead of natural gas, but it produces 4 kWh of heat for every 1 kWh of electricity it uses. It costs \$14,000, but it's very low-maintenance and it also replaces the air conditioner and water heater.
- A grid-tied solar array. This system is connected to the electrical grid so that when it generates more energy than the house needs, the extra electricity can be sold back to the grid. Over the whole year, the house will use as much electricity as is sold back, which means the homeowner would basically be heating and cooling the house for free. It costs \$16,000 to install.

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