A New Heating System

Task Statement 1

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 used, 60 kWh of heat is produced. With the homeowner's current system, heating the house costs $975 to heat the house.

Research at least two other options available in your area that could replace the homeowner's heating system. 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 used. 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 used. These systems also could be replaced if there are cheaper options, but doing so 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 costs?

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Task Statement 2

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 used, 60 kWh of heat is produced. With the homeowner's current system, it costs $975 to heat the house. Assume that natural gas costs $0.05/kWh and electricity costs $0.21/kWh.

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Here are three other types of heating systems that could replace the homeowner's current system:

- A new furnace, which also runs on natural gas but is more efficient. For every 100 kWh of natural gas used, 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 used. It costs $14,000, but it's very low-maintenance and also replaces the air conditioner and the 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 is sold back to the grid. Over the course of a year, the house uses as much electricity as is sold back, which means the homeowner basically heats and cools the house for free. It costs $16,000 to install.

1. Which system would you recommend? Make a graph to convince the homeowner to switch to this system.
2. How long will it take to save as much money as the new system costs?