Energy Optimization in residential spaces using BEopt

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Abstract

The residential sector in the United states accounts for 22 percent of the total energy consumption according to the reports from U.S. Energy Information Administration (EIA) (2013). 31 percent of the house holds are reported facing challenges in paying their energy bills for heating or cooling their homes in 2015 according to the Residential energy consumption survey (RECS). To promote green buildings and to reduce the carbon footprints. The US Green building council has developed LEED certification to evaluate energy performance of a building.

Figure 1.1 LEED Certifications

To achieve this level of energy efficiency software's such as BEopt, Equest are used. These software's help evaluate building design and identify cost optimal efficiency to save energy. This research project compares results of the software and average energy costs per household to determine housing design adjustments to minimize energy usage for different geographic regions in the Northern US. Data are taken from government website such as EIA and census.gov These results can be used to inform housing design and retrofit and remodeling actives.

Objective

- The first objective of this paper is to find out the threshold energy consumption in Connecticut.
- How does the geographic location affect the energy consumption? Is the EIA classification of climate zones adequate to decide the specifications for insulation and heating.
- Important things that need to be considered during the designing or building a house
- Small changes that can be made to reduce energy consumption

Model

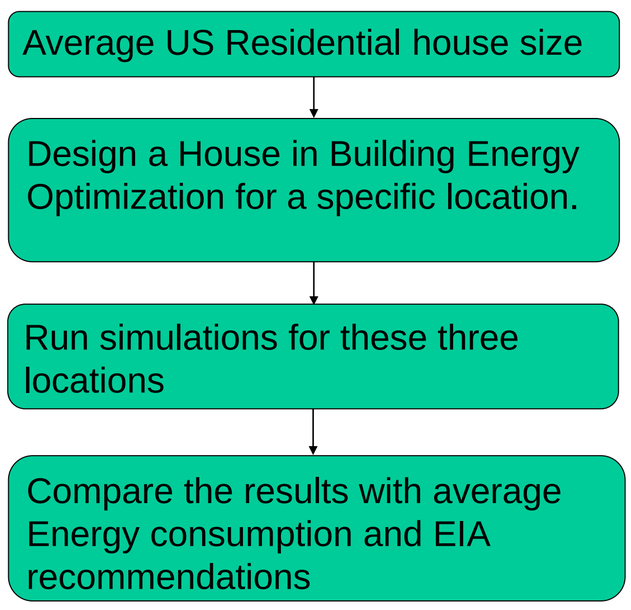

Figure 2.1

Result

- The threshold energy in the state of Connecticut is found out to be 166.09 MMBtu.
- The EIA classification of use of insulation proves to be inadequate to save energy.
- One of the most important thing to be considered when designing or building is its orientation. Windows facing east clearly save a lot of energy by using the solar energy.
- Some of the small changes that can help the energy consumption are
  - Having a set point for setback temperature. Which sometimes saves almost 10 percent of your energy.
  - Glazing windows, energy efficient windows will improve help save considerable energy
  - Making sure of the air leakages
  - Energy saving Light bulbs
- Some of the big changes that can or increase the efficiency of the building are as follows
  - High quality installation of insulations
  - Good quality wood studs.

Methodology

- An average residential house is designed in the BEopt using the building codes provided by the government.
- Three different locations in different states are selected to calculate the energy consumption in each state
- The threshold residential energy is calculated using data provided by EIA and Census.
- The same houses are designed with better retrofits
- Energy consumption of both the houses are then compared
- The simulation for a generic house is carried out as follows:
- Use the parameters provided by the government building code
  - Insulation material
  - Air Leakage thresh hold values
- The simulation for modified house is carried out in following steps:
  - Adding better insulation
  - Setting a set back point helps save almost 10 percent of the energy consumption as shown in figure 3.1
  - Installing quality glazing windows
  - Decreasing the air leakage

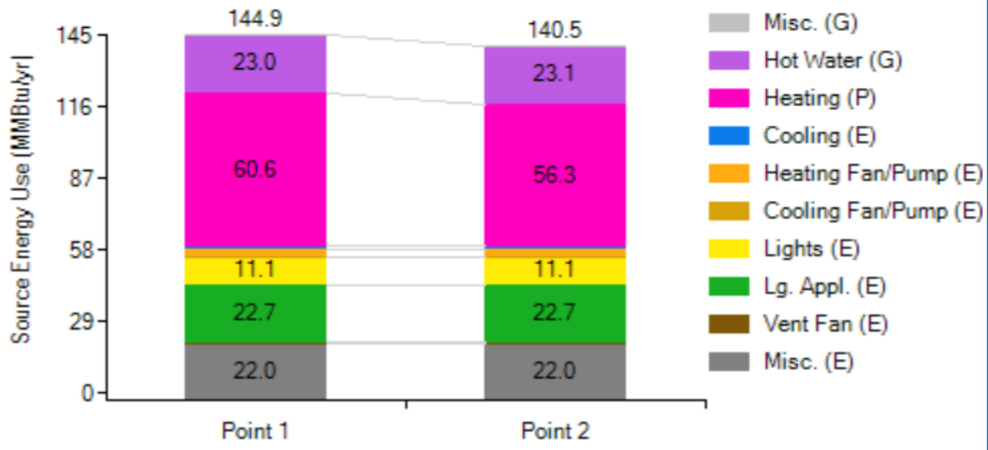

Figure 3.1 energy consumption after setting setback temperature and better windows

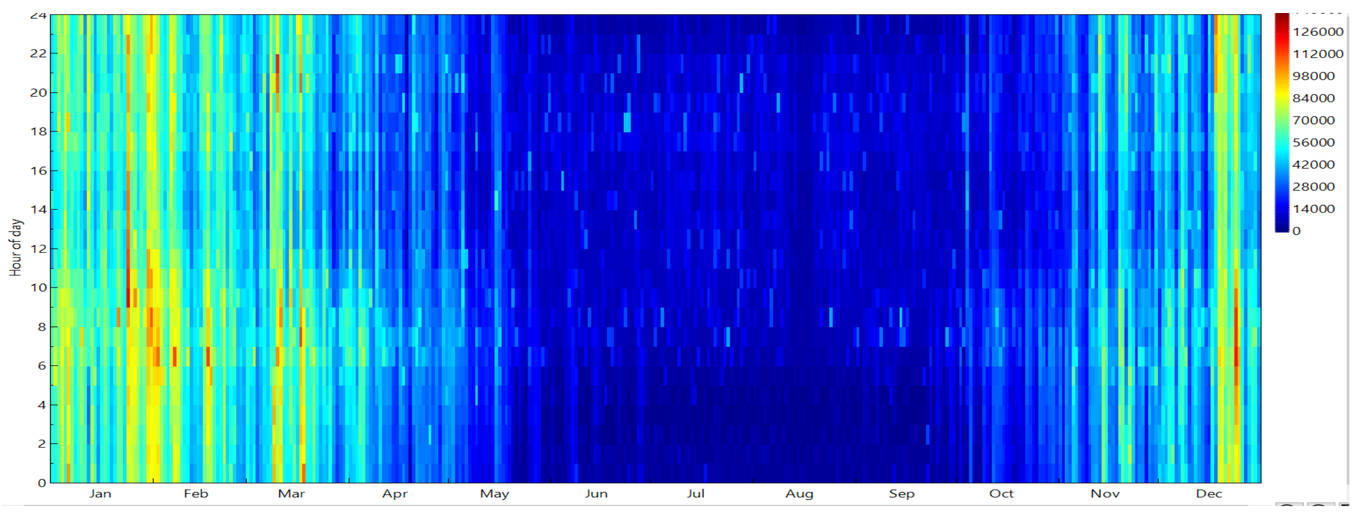

Fig 3.2 Hourly Heat map of the simulated model

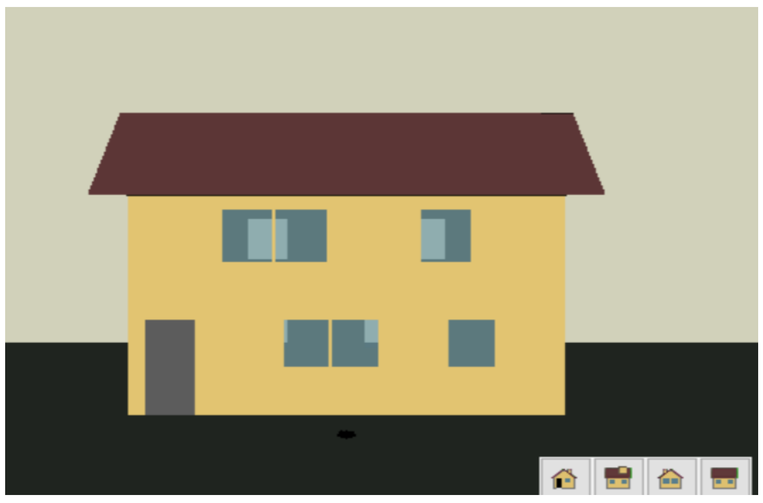

Fig 3.3 Simulated Model

Conclusion

There are various factors that affect the energy consumption which include size of windows, Quality of insulation installation, glazing windows, set back temperature and air leakages. However not all factors are considered in the minimum requirements for residential buildings in climate zone 5. It only considers the minimum insulation requirement but ignores the fact that the installation quality can affect a very good quality insulator. Factors like window sizes, setback temperature also have a great impact on the energy consumption.