Heating cost calculator

1. Introduction

The application measure the cost of heating a room from a certain temperature to another with different kind of materials (wood, electricity or coal) in different countries (Germany, Italy or Sweden). The inputs from the user are the desired increase of temperature, the volume of the room, the material type and the country. Within the application there is a button for the calculation of the energy and one for ranking the solutions based on the most economic material in one country or best country to use one material.

2. Working process, math and physics behind

I started the project building up the buttons that I thought I needed and then writing simple codes for input and output to test them. After I build up a function able to calculate the energy needed to heat up a room from one temperature to another and called the variable dbEnergy. The next step was to create two listboxs in order to give the user the possibility to choose different type of materials in different countries. After writing the functions in a new form and calling them in the main.

The next step was to search for the physics fundamentals behind the application. In order to make the application not so complicated I made some statements that I will list them in the following paragraph. I started from the equation that the energy released ($\mathbf{E_R}$) from the heating device is equal to the energy needed ($\mathbf{E_N}$) to heat the air from one temperature to another.

$$\mathbf{E_N} = \mathbf{E_R}$$

The needed energy is calculated multiplying the difference in temperature with the mass of the gas that need to be heated and multiplied with the heat capacity of the gas. The mass can is expressed as volume multiplied by the Density of the gas.

$$\mathbf{E_N} = \boldsymbol{V} * \boldsymbol{D} * \mathbf{H_C} * (\mathbf{t_1} - \mathbf{t_0})$$

The difference ($t_1 - t_0$) is given as an input by the user under the variable of dbtemperature, same for the volume under the variable dbvolume. Now we can calculate the needed energy under the variable dbenergy. The air density and the heat capacity of the air are constants. The released energy is calculated as follows:

$$E_R = M * C_m$$

where M is the mass of the heating material and C_m the constant coefficient of releasing energy of the material. From these two equations we can calculate the mass of the material need to heat the room to a certain temperature. Then we can easily calculate the cost multiplying the mass with the price.

3. Encountered problems

From the programming point of view I had small problems like declaring variables two times and then the value of the solution was not the expected one. After consulting the internet I could find the mistake. Another problem I had was that the select case function. I wasn't able to make it work with the multiple cases that I had within my program. After debugging I learned that the program was stuck in the first case of if and didn't continue in the other cases. I switched to Enum and it worked.

The most time consuming problem was that of gathering the data of different coefficients and prices. The best websites with the data were the one from the USA but I had to convert from the empirical to the metric system . I had also problem finding the prices, specially for a specific material in a specific year in a specific country.

4. Notes:

*All the energy given from the heating device is used to heat the air of the room and there are no losses of any kind of energy in the process.

*The calculated cost is that of the process from the initial temperature to the desired one and not maintaining it for a longer time.

*The coefficient of the gas material is taken from those of the natural gas.

*The prices of the materials are used those of the year 2018.

*Due to lack of data of the price of the coal in the year 2018 in Italy and Sweden, estimated prices was used.

References:

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