

Electricity Generation

Electricity is generated nationwide from a number of sources, including coal, nuclear, hydroelectric, wind, and more. The US Energy Information Administration (EIA) publishes various reports each year related to energy.

Some of the reports are located at <https://www.eia.gov/electricity/data/browser/>. One of the reports is:

Net generation United States all sectors monthly. This report was reformatted and saved as a text file named **Electricity.txt**. It is shown below and is available on the course website.

The file **Electricity.txt** is arranged as follows.

Column 1 contains the year (2018 – 2001)

Columns 2-8 contain the following information:

Column	Energy (in Thousand Kilowatthours) generated by	Energy Category
2	All fuels	
3	Coal	Fossil Fuel
4	Natural Gas	Fossil Fuel
5	Nuclear	Nuclear
6	HydroElectric	Renewable
7	Wind	Renewable
8	Solar	Renewable

Note that column 2 is somewhat greater than the sum of columns 3-8 since not all energy sources have been listed (such as geothermal and biomass).

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Electricity.txt - Notepad
File Edit Format View Help
Net generation United States all sectors monthly
https://www.eia.gov/electricity/data/browser/
Source: U.S. Energy Information Administration
All values in thousands of megawatthours
Year  all fuels  coal  natural gas  nuclear  hydroelectric  wind  solar
2018  347576.0  95496.8  122393.9  67257.0  24377.0  22720.8  7780.4
2017  336189.2  100486.3  108034.6  67079.1  25027.8  21191.9  6439.7
2016  339722.9  103262.4  114858.9  67141.2  22317.7  18916.0  4572.2
2015  339800.1  112699.8  111123.5  66431.5  20756.7  15893.2  3252.7
2014  341133.8  131809.2  93884.1  66430.5  21613.9  15137.9  2410.3
2013  338830.3  131759.6  93736.3  65751.4  22380.4  13986.6
2012  337313.8  126170.2  102157.8  64110.9  23020.0  11735.1
2011  341678.4  144452.5  84474.1  65850.4  26612.9  10014.7
2010  343755.0  153940.9  82308.1  67247.4  21683.6  7887.7
2009  329194.2  146325.4  76748.2  66571.2  22787.1  6157.2
2008  343282.3  165483.4  73581.7  67184.0  21235.9  4613.6
2007  346395.4  168038.0  74715.8  67202.1  20625.8  2870.8
2006  338725.2  165875.9  68036.7  65601.6  24103.9  2215.8
2005  337951.9  167739.4  63413.4  65165.5  22526.8  1484.2
2004  330879.6  164858.4  59175.0  65710.7  22368.1  1178.6
2003  323598.8  164478.1  54159.0  63644.4  22983.9  932.3
2002  321537.7  161094.2  57583.8  65005.3  22027.4  862.9
2001  311387.0  158663.0  53260.8  64068.9  18080.1  561.4

```

Program Requirements:

Write a C++ program according to the following requirements:

1. Open the data file **Electricity.txt** and read each column into an array (8 arrays total).
2. Also create 2 arrays for the following:
 - **Total Fossil Fuel Energy** (sum of all fossil fuels)
 - **Total Renewable Energy** (sum of all renewable sources)
3. Give the user menu three options, including:

Option A: Display a report showing the energy source, the energy produced and the percentage of the energy for all fuels for a given year. Prompt the user to enter the year.

Example: If the user enters **2018**, the report might look like:

Energy produced by different sources for the year 2018:

Category	Energy (Thousand Kilowatthours)	Percentage of total energy
Coal	95496.8	27.5%
Natural Gas	122393.9	35.2%
Nuclear
...
Solar

Option B: Determine the year in which the peak production of electricity occurred for any of the 7 categories. Also display the value of the energy generated.

For example, if the user selects nuclear as the category, the output might be:

The peak production of electricity by hydroelectric power of 26612.9 thousand kilowatt hours occurred in 2011

Option C: Create an output data file to be later opened by Excel in order to graph:

- The file should contain the year and one of the following 16 categories (prompt the user to select one of the 16):
 - One of the 8 categories of energy (for example, **Natural Gas Energy** or **Total Renewable Energy**)
 - The percentage of total energy (all fuels) for any of the 8 categories above (for example, **Percentage of Natural Gas Energy** or **Percentage of Total Renewable Energy**).
- **Examples:** If the user selects **Natural Gas Energy**, then an output data file should be produced by the program that looks similar to the file on the left below. If the user selects **Percentage of Natural Gas Energy**, the file would look similar to the file on the right below.

Note: Percentage of Natural Gas Energy is calculated by dividing Natural Gas Energy by Energy from All Fuels and multiplying by 100. In 2018,
 Percentage Natural Gas = $122393.9 / 347576.0 * 100 = 35.2\%$

```

NaturalGasEnergy.txt - Notepad
File Edit Format View Help
2018,122393.9
2017,108034.6
2016,114858.9
2015,111123.5
2014,93884.1
2013,93736.3
2012,102157.8
2011,84474.1
2010,82308.1
2009,76748.2
2008,73581.7
2007,74715.8
2006,68036.7
2005,63413.4
2004,59175.0
2003,54159.0
2002,57583.8
2001,53260.8

```

```

PercentNaturalGasEnergy.txt - Notepad
File Edit Format View Help
2018,35.2
2017,32.1
2016,33.8
2015,32.7
2014,27.5
2013,27.7
2012,30.3
2011,24.7
2010,23.9
2009,23.3
2008,21.4
2007,21.6
2006,20.1
2005,18.8
2004,17.9
2003,16.7
2002,17.9
2001,17.1

```

Additional program requirements

- 1) Allow users to correct any bad inputs (invalid year, invalid menu choices, etc.)
- 2) Note that Solar should only be a valid choice for 2014-2018.
- 3) Allow the user to specify the name of the output data file for Option C.
- 4) Produce an error message if the program can't locate the file Electricity.txt

Test Cases

Run the program for the following test cases and turn in the results:

- 1) **Option A:** Generate reports for 2002, 2018, and at least one more year.
- 2) **Option B:** Generate reports for Wind Energy, Hydroelectric Energy, and one more choice.
- 3) **Option C:** Generate data files for Wind Energy, Percentage of Coal Energy, and one more choice. Open each of the three data files in Excel and create a nicely formatted column graph (add title, label axes, add gridlines, etc.) Be sure to print the data file as well as the Excel file (showing both the table and the graph).

Extra Credit Suggestions: (for a maximum of 10 additional points on the program grade)

1. Use a *string* array to store the names of each category. This is also recommended as it will greatly simplify your code in generating your menus.
2. Add additional menu options.
3. Rather than using one-dimensional arrays for each type of energy, store all energy types in a single two-dimensional array.
4. Send the information from Option A to a data file, open it with Excel, and then use Excel to produce a Pie Chart.
5. Use your imagination!