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Go Green! Application

Objective

In this app, users can select climate stabilization wedges that reduce global carbon emissions. Since each wedge represents a different approach to carbon emission reduction, this app will allow its users to determine which combination of certain wedges will yield an overall more effective and cost efficient solution to the carbon problem.

Algorithm

After the user inputs the file names into text boxes and presses the “Read Files” button, the code looks for the words “wedges,” ”constraints,” and “strategy.” If these words are found, it then extracts the data from each file line by line and inputs them into an array. If the files are not in the right path, a warning message tells the user to move them into the correct directory. Afterwards, information and brief explanatory text for each wedge are displayed in the table, which has checkboxes that allow the user to select different wedges of their choice. The user can specify how many of each wedge and the different years each wedge should start by entering these values into another 2 columns in the table. If the user does not specify the starting year before checking the box, a warning is displayed because the start year is needed to plot the wedge. Using a for loop, the code then checks which wedges are checked and plots each wedge based on the year values that are inputted with each wedge’s corresponding color. If different years are inputted, the years are sorted using a bubble sort algorithm and the wedges are plotted in order. Within this same for loop, the code also checks if the user has made selections that align with the constraints specified in the constraints file. If not, a warning message is displayed that notifies the user to make the suitable changes. When the user outputs their strategy, the code checks if one wedge accounts for more than half of the total chosen wedges and displays a warning message if this is the case. Additionally, the user can select what information they want to graph using a drop down menu: carbon emissions over time, carbon dioxide concentrations over time, or mean warming over time. This is also checked in the same for loop, and the code plots the desired information based on branching statements using string comparisons. When mean warming over time is selected, the default value for lambda is 0.7, but the user may change this value by inputting it in the text box. The code also plots the flatline emissions based on the starting years inputted. Because all of these components are in the for loop, both the table and graphs change with every change the user makes, allowing the user to add or remove any information they desire.

After the user specifies all of their selections and the data is plotted in the graph, the code creates a text file that lists information about the selections they have made. Most of these pieces of information were taken by indexing the wedge data that was extracted after the “Read files” button was pushed, but the number for each wedge used and the total costs were taken based on the information inputted into the table.

Another part of the code uses a numerical text value box to display the total number of wedges selected by summing the corresponding values in “NumberUsed” column of the table. The same method was used to show the total costs of the user’s selected wedges. The user can also use a drop down menu that shows how many wedges are needed to flatline the carbon dioxide emissions the first year they are implemented, cut emission to the 1990 levels, or cut emissions to 80% below the 1990 levels of emission. This feature was implemented using a while loop that counts the wedges until the goal is reached. Finally, a “Clear All” button was implemented that lets the user reset all of the information chosen.

New Wedge Proposal: Cow Diet Reform

Cows are known to produce a large amount of methane. There is a type of seaweed, Asparagopsis Taxiformis*,* which can reduce methane production in cows by 99% when added to their diets (2). Methane traps 25 times more heat in our atmosphere than carbon dioxide does in a 100 year period (3). The equivalence of methane-to-carbon in terms of tonnes would be 25:2.47. This means only 3.47% of cows need to be fed the seaweed. Knowing the amount of cows in the world (4), the amount of seaweed needed to reduce methane emissions by one gigaton of carbon dioxide per year, and the amount of seaweed produced per hectare (4), the space needed for this is about 70,000 square kilometers. The cost for this is 1.4 billion dollars to provide the land and equipment (5). Although it requires a great deal of land, the amount of methane reduced for amount of cows fed is very small and can easily be increased to reduce even more methane.

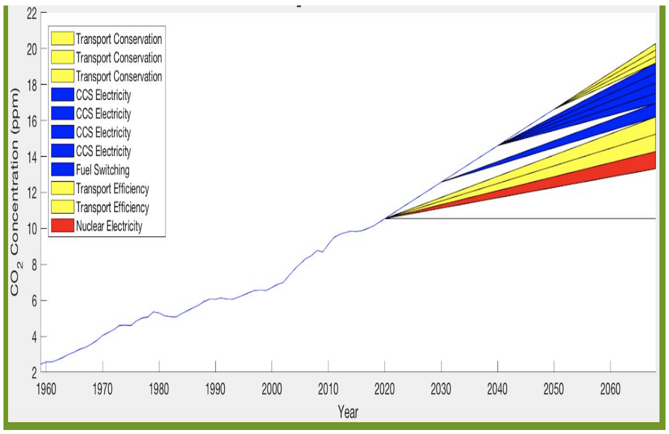
Sample Output

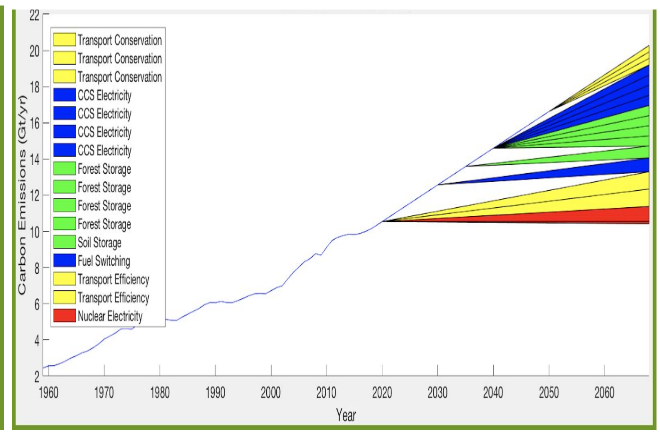
After reading in the files, we first start by implementing 2 Transport Efficiency Wedges, 3 Transport Conservation Wedges, 4 CCS Electricity Wedges, 1 Fuel Switching Wedge, and 1 Nuclear Electricity Wedge by inputting their starting years, checking the boxes next to them, and then specifying the number of each desired.

ID	Category	StrategyName	Sector	Description	Needs	Challenges	Cost	SelectedWedges	NumberUsed	StartYear
1	Efficiency a…	Transport Efficiency	Transportation	Increase au…	Double effic…	Car size an…	1	✓	2	2020
2	Efficiency a…	Transport Conservation	Transportation	Reduce mil…	Cut miles tr…	Increased p…	1	✓	3	2050
3	Efficiency a…	Building Efficiency	Electricity,Fuel	Increase in…	Use best av…	House size,…	1		0	
4	Efficiency a…	Electrical Efficiency	Electricity	Increase ef…	Raise powe…	Increased p…	1		0	
5	Fossil Fuel	CCS Electricity	Electricity	90% of CO…	Inject a vol…	Possible le…	2	✓	4	2040
6	Fossil Fuel	CCS Hydrogen	Transportation,Fuel	Hydrogen f…	Produce hy…	New infrast…	3		0	
7	Fossil Fuel	CCS Synfuels	Transportation,Fuel	Capture an…	Use CCS at…	Emissions …	2		0	
8	Fossil Fuel	Fuel Switching	Electricity	Replace co…	Use an am…	Natural gas…	1	✓	1	2030
9	Nuclear	Nuclear Electricity	Electricity	Displace co…	About 3 tim…	Weapons p…	2	✓	1	2020

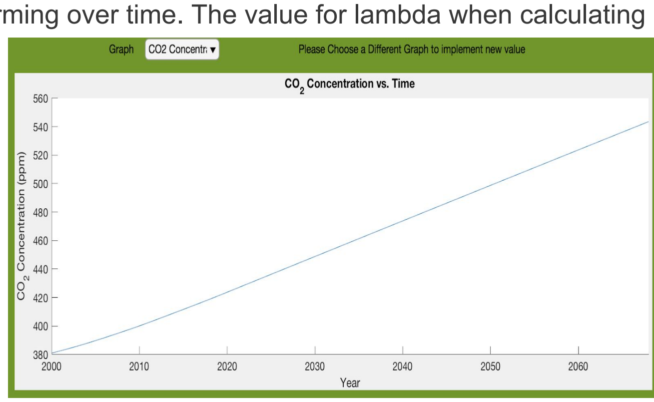
The graph after doing so looks like this. It is clear that this combination of wedges does not reach the flatline, so we decide to add more until we reach our goal. We choose to add the 2 wedges below, and the wedges now flatline. When we try to add wedges beyond the constraints, a warning message is shown that tells us to change the selections we just made. The constraints can be seen in another table for the user's convenience.

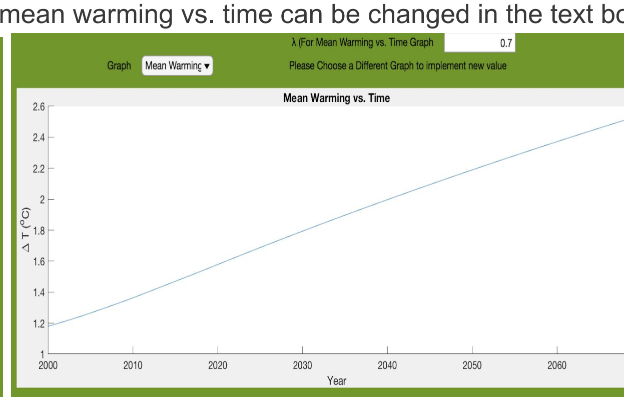
14	Renewable…	Forest Storage	Biostorage	Carbon stor…	Halt defore…	Biodiversity,…	1	✓	4	2040
15	Renewable…	Soil Storage	Biostorage	Farming tec…	Practice car…	Reversed if…	1	✓	1	2035





Using the drop down menu, we can also see the graphs of carbon dioxide emissions over time and the mean warming over time. The value for lambda when calculating mean warming vs. time can be changed in the text box.





We now see that this is a viable combination of wedges for reaching the flatline emissions. The total number of wedges used and the total cost of the combination we made is displayed in text boxes. We then push the "Output Strategy" button, and a text file is made that shows us the strategy we have created. We can continue again with this process by first using the clear all button.This will let us to compare different combinations of wedges, helping us pick the most efficient way to make our planet greener.

Total Number of Wedges Used	16
Total Cost of Wedges	21
Number of Wedges to Reach flatline emissio	11

Works Cited

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