The following document will walk you through how to operate the Michigan Legislative Modeling Tool, created in 2024 by Master's of Engineering Applied Climate student Brian Cromwell at the University of Michigan. Tool created in partnership with the Michigan Department of Energy, Great Lakes, and the Environment.

Intro and Opening the Program

The program is accessible through Google Collab or through the Jupyter Notebook software, part of the free Anaconda program. To learn more about Anaconda or to download the software, visit https://www.anaconda.com/download for more information.

Once the program is open, run all of the cells. In Google Colab, go to the Runtime Tab, then click "Run All". In Jupyter Notebook, go to the Kernel Tab and select "Restart and Run All". The code will not run all the way through, but this is intentional. Scroll down to the custom variable input and type "clear" into the box that prompts you to enter a reduction measure. This will ensure that all of the variables are reset and allow the rest of the code to run smoothly. Once you type "clear" and press enter, wait for the rest of the cells to run. You are now ready to work with the Michigan Legislative Modeling Tool.

Pre-Existing Reduction Measure Tool - All or Nothing

The first part of the tool works with the existing reduction measures, allowing you to turn on and off any of the measures in full. The tool comes default with all of the measures turned off. In order to turn on any of the desired measures, find the box beneath the heading with the same name as this document, where there are 10 lines of code beginning with RM. Each line corresponds to the reduction measure with the same number. Set any lines corresponding to the measures you want active to "True", and then press Shift+Enter. Press Shift+Enter twice more to see the output of the active reduction measures as a graph. To turn the reduction measures off, simply change the "True" value back to "False".

Pre-Existing Reduction Measure Tool - Split Goals

The split goals part of the tool is very similar to the All or Nothing tool. Before using this tool, familiarize yourself with the milestones for each reduction measure. Then, turn on any measure goals that you wish to achieve by changing the "False" value to "True". Some have values for 2030, some have values for 2050, and some have both. If a measure has a goal for both 2030 and 2050, do not turn on the 2050 goal while leaving the 2030 goal false. The program will not take into account the 2050 measure if both are not set to "True". Once you are satisfied with your inputs, press Shift+Enter three times in order to produce the graphical output.

Custom Input

The custom input part of the program is the most complicated part of the program, but has the most instructions built into it, so using it should still be straightforward! Scroll past the percentage cells and function cells to find the header that says “Input Reduction Measure Parameters Here”. Run the box below the text by pressing Shift+Enter.

You will then be prompted to enter a reduction measure number 1-10 into the box. When you have put the number into the box, press enter. Alternatively, if you wish to clear the log, type “clear” into the box, which will reset all previous inputs into the program.

After the number is input, you will be prompted to enter a percentage of the reduction measure you wish to achieve. This is again a time where familiarizing yourself with the reduction measure goals is important! After entering the percentage, you will be prompted to enter a year between 2025 and 2050 for which this measure will be achieved.

The next prompt will ask if you want to work with the entire population of Michigan. Enter “Y” or “N” accordingly for Yes or No. It is useful to work with the entire population for a statewide bill that is being passed, while a city level bill may impact fewer people. The final graphical output gives a representation of the state level impact. If you type “N” into the box you will be prompted for the population that will be impacted by that measure.

Lastly, you will be asked if you would like to download the output as a text file. Type “Y” or “N” accordingly. If you type “Y”, the file will be downloaded with the name “Yearly Output.txt”. If you wish to save the results for future use, be sure to rename the file after you download it, as the next file downloaded will overwrite the one before it.

Once you are finished with the inputs, the box below will allow you to add any existing additional reduction measures onto the output by changing the lines from “False” to “True”. Do not turn on measures that you have input in the custom boxes yourself, as that will override the custom measure you have put in.

Press Shift+Enter twice to display two tables and a graph. The first table is the total reduction in CO2e for each reduction measure in total. The second table is the yearly impact from each reduction measure, as well as a total. The total column in the second table includes the business as usual changes, so it will likely not add up perfectly with the other values to the right of it in the table, but that’s okay. The graph is the same as the other parts of the tool, displaying a business as usual case and the result of the model.

If you wish to add on another custom reduction measure, simply repeat the process again. This version of the model does not currently support different time frame goals of the same reduction measure number, so do not re-enter a number that you have used previously. Run the cell below the tables and graph output to check what you currently have saved in the log.