

***Notes on the DICE-2023 Excel Version***  
***Version “DICE2023-Excel-b-4-3-10-v18.3”***  
***November 13, 2023***

The Excel version of DICE is a program that can be used for many purposes for understanding and testing the current authoritative GAMS version. It has a few differences and fewer capabilities but does not require proprietary software and is more user-friendly.

**Version**

There is currently only one version, which is the “advanced” version. The *advanced version* contained three scenarios and can be used to optimize for the savings rate and the emissions control rate. In addition, it contains the output of the GAMS version.

The current versions use the GAMS solutions for the control variables. The savings rates can be optimized in all versions, and the emissions control rates for 2025 and beyond can be optimized for the “Opt” and “Lim2” scenarios. Note that because of the hard temperature constraint in Lim2, Solver generally will not solve without a lot of work.

Please read the “Version Notes” on the first sheet of each file for a general overview and “Interpretation” for a guide to the different parts of each spreadsheet

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## Support

For any errors, please email [william.nordhaus@yale.edu](mailto:william.nordhaus@yale.edu).

Unfortunately, we do not have resources for technical support for the DICE model. We will try to answer questions about the model but cannot help with running Excel or Solver.

## Changing Parameters

For users who would like to change parameters, here are some guidelines:

- The best way to change parameters is in the “Parameters” sheet. However, you should verify that these link in the sheet for the scenarios before changing. A few non-key parameters are in the main model spreadsheet.
- Some parameters can be changed without worrying about the results in the “Base” case. For example, changing the damage ratio or the abatement cost in the “Base” case will have little effect on the outcome. However, other changes will have more substantial effects, such as those affecting the discount rate.
- In general, any changes for the “Opt” and “Lim2” cases will change the optimal policies and therefore require reoptimization (see how to reoptimize below). For example, reducing the cost of the backstop technology by 50% leads in the “optimal” scenarios to an increase in the control rate of about 40%, a decrease in the carbon price of about 13%, a very small increase in the optimal savings rate, and a decrease in global mean temperature in 2100 of 0.5 °C. If the backstop parameter is changed *without* reoptimization, there is no change in climate outcomes, and the solution is therefore incorrect.

### Reoptimization and alternative solutions

If you change parameters, you will probably want to reoptimize. Reoptimization can be achieved using “Excel Solver,” which is a standard add-on to Excel. The current version contains the program for Solver. Using Solver requires some practice, but once mastered, it can be used to solve for alternative scenarios. Here are the steps:

- Load Solver into Excel as an add-on.
- Solver usually shows up in “Data” on the right hand side. Start there.
- Once you open solver, the dialogue box will allow you to maximize the present value of utility (cell B66) with variables being the emissions control rates from 2025 to 2100 (cells C71 to R71). You may also want to optimize the savings rate (cells C69 to R69). You generally should make sure that these are non-negative. You may want to constrain more tightly to improve the solution.
- It is highly recommended to save the file again at each point and *before* solving (optimally with another name) because you cannot recover the file if the next step fails.
- Then solve. If you are successful, the program will say you have found the optimal solution (“Solver has converged to the optimal solution.”). You can compare with other versions as is usual with Excel sheets. If it fails, then there is a mistake, and you need to correct it.
- You may get a message that says “Solver could not find a feasible solution” with a big red exclamation point. You should “Restore original values” or you will lose your last step. That is why we recommend saving often.
- Sometimes you may want to be more ambitious. If so, you can buy the commercial version of Solver from Frontline Systems for less than \$1000.

For those just starting with modeling climate change, we wish you, Bon Voyage.