

SGM Users Guide I

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Model Release

This is a first, and partial, release of the Second Generation Model. It includes files needed to run a baseline scenario for the United States and a set of prototype carbon management scenarios. Later releases will include the Fortran source code and files needed to operate other SGM regions.

The SGM allows for analyses of two types of carbon management experiments: the impacts of

- carbon fees related to the carbon and/or carbon-equivalent (CE) emissions and
- emissions targets set at a regional or global level.

In the carbon fee scenarios, fees are set exogenously at a level determined by the user, and are translated into additions to the price of each fossil fuel. In carbon management experiments using a carbon target rather than a price, the user exogenously specifies the target level of emissions for the economy as a whole and the model determines the carbon price necessary to achieve the desired target.

The first release of the SGM allows the user to execute the model and/or explore three sets of model outputs for the US. Model outputs presented are a baseline case, the response of the model on a \$100/ton carbon-equivalent (starting in 2015) case and a carbon-equivalent emission target case (a return to 2005 carbon equivalent emissions by 2015). The incorporation of not only CO₂ but also of other important greenhouse gases like CH₄, N₂O, HFC-23, PFC, SF₆ and a set of HFCs, whose impacts can be expressed in carbon-equivalent emissions enables the user to design policies that target these gases collectively and to assess the impact of carbon management actions on this suite of greenhouse gas emissions.¹

We have provided the example runs to illustrate model capabilities. They should be interpreted as illustrative.

¹ Note: no users guide nor any set of example runs could adequately instruct a potential user on every variable used in the model or on the impacts of every data point on every model result. SGM's documentation (PNNL-14256) and overview document (PNNL-14916) are available from <http://www.epa.gov/air/sgm-sab.html> and <http://www.globalchange.umd.edu/?models&page=sgm>.

The Hardware and Software Requirements

The Second Generation Model, as provided, is designed to run on a Microsoft Windows Systems with Microsoft Office Professional installed.

To operate the SGM, one will need the following software:

- Microsoft Excel to run the model and view the data in an efficient manner and
- Microsoft Access which serves as a user interface to the database in which SGM results are stored.

The zipped plus unzipped package will require approximately 10,000 KB.

The dataviewer requires the *ddao36.dll* file which can be found on your computer if you have installed any of the Microsoft packages listed under <http://support.microsoft.com/dllhelp/default.aspx?fid=96>. You may have to copy that file to the \exec directory (see Appendix for the directory structure).

The Zipped File

After obtaining the zipped package, please unzip to any desired location. It is vital to maintain the directory structure as in the zipped package. Check the directory structure against the directory structure described in the Appendix.

Running the Model

The preferred method of running the model is through use of the *RunSGM_US.xls* user interface. *RunSGM* allows the user to set up multiple input sets, and run them either individually or in batch mode. The SGM can also be run by simply double clicking the executable file. If one does so, file paths in the SGM control file *sgmctrl.csv* will be followed. This control file is described below.

NOTE: THE FIRST TIME THE MODEL IS RUN THE USER MUST AGREE TO A LEGAL NOTICE. A DOS window will appear when executing the first model run. Please follow the instructions on that DOS window for the first model run. If the RunSGM interface is used, you may have to bring this DOS window to the foreground.

Once the model run or runs are completed, and the data is written to the database, the preferred method for looking at the output is through use of the *Dataviewer_US.xls* user interface. The procedure for using *RunSGM* and the *Dataviewer* to run the model and view output is as follows:

(1) Open *RunSGM_US.xls* and enable macros. **NOTE: Use of the excel interfaces requires that Macro's be turned on. If a security warning pops up on the screen, click on the Excel tab "TOOLS", then on "OPTIONS", then on "Macro Security" at the right and bottom of the options screen and click on "medium security" on the security screen.**

Next, back in RunSGM:

(2) Click on the "Main" tab and click on the "Refresh Lists" button.

(3) Select the desired input set from the "List of Input Sets". The user may select a single input set, or multiple input sets to be run in batch mode. **NOTE:** under the "CtrlHeader" tab in *RunSGM_US.xls* the user can specify the name of the excel output file *sgmgen2004_us.csv* for a specific run. When a set of runs are executed, however, the name on line (12) on the "CtrlHeader" excel sheet is used for all runs and the final *sgmgen2004_us.csv* output will be from the last scenario run.

- (4) Click on the “Run SGM” button.
- (5) After clicking on “Run SGM,” a “SGM Control Macro” dialog box will open, indicating the current status; the *Dataviewer_US.xls* file will open; the selected input set will be written to the *sgmctrl.csv* file; a DOS window will open; and the model will read the input files listed in the *sgmctrl.csv* file and begin to run. **NOTE:** see above for instructions for the first run.
- (6) When the model has completed the run or batch of runs, click on the “Done” button in the “SGM Control Macro” dialog box.

(7) The user ought now, to be viewing one of the *Dataviewer_US.xls* user interface excel sheets. Please click on the “Single Query” tab if the Dataviewer first shows another sheet. “Click on the “Refresh Lists” button. **NOTE: If the dataviewer does not respond as described above, be sure that the *Dataviewer_US.xls* is pointing to the correct *SGM_us.mdb* in the \output directory:** under the dataviewer’s tab “Select Database”. **NOTE:** if the \exec subdirectory does not contain the *ddao36.dll* file, the user will get a warning because the data can not be moved to the database. A *sgmgen2004_us.csv* file can still be found in the \outputs subdirectory, which can be analyzed. **NOTE also** that if for some reason, the data is not correctly moved, when the *ddao36.dll* is present, the data might reside in the “Fortran Text Buffer” and the data can then be physically moved after clicking the “Manage Data” tab in the *Dataviewer_US.xls* (this might occur if a model run is executed by double clicking the *sgm.exec* file directly). **NOTE also** that if the dataviewer appears with a BASIC debug sheet, then just click on the small square box at the top bar of the debug sheet and delete that debug sheet (e.g. this will occur if you have a *sgmctrl.csv* file open). Just run the model again after the debugging is taken care of.

- (8) In the Dataviewer, from the “Model Run(s)” list, select the desired run(s).
- (9) From the “Region(s)” list, select the desired region(s). For *Dataviewer_US.xls* only the US as region is listed.
- (10) Click on the “Search VarID’s” button. This will open the “Search Variable ID’s” dialog box where the user may select the variable(s) to be sent to the “Output” sheet.
- (11) In the “Search Variable ID’s” dialog box, the user may either, scroll down and select any number of variables, or the user may select a specific category of variables from the “Category” pull down menu, and then select any number of variables.
- (12) After the desired variables have been selected, click on the “Immediate Query” button. The selected variable(s) from the run(s) and region(s) selected are written to the “Output” sheet, and a graph of the selected variables is generated.
- (13) The user may then return to the “Single Query” sheet, and select a different set of run(s), region(s), and variable(s) to write to the “Output” sheet. Additionally, the user may select a different type of graph from the “Query/Chart” pull-down menu on the “Single Query” sheet.

Alternatively, the user may select the “Group Query” tab, and view the output for a group of variables by selecting a run from the “Run” list, selecting a region from the “Region” list, selecting a group of variable from the “Groups” list, and clicking on the “Compare Runs” button.

The other method of running the model is to simply double click on *SGM.exe* executable file. The model will run using the set of input files in the *sgmctrl.csv* file. When the model has finished running, open the *Dataviewer_US.xls* file, select either the “Single Query” or “Group Query” tab, click on the “Refresh Lists” button, and follow the procedure above to view the output². To run different scenarios using this

² Again: If the dataviewer does not respond as described above, be sure that the *Dataviewer_US.xls* is pointing to the correct *SGM_us.mdb* in the \output directory: under the dataviewer’s tab “Select Database” and that the *ddao36.dll* file is in the \exec directory. NOTE also that if the data is not correctly moved, the data can be physically moved after clicking the “Manage Data” tab in the *Dataviewer_US.xls*.

method, the *sgmctrl.csv* file must be modified to include the appropriate list of input files and desired name of the excel output file. This can either be done manually, or, preferably, by selecting the desired scenario from the “List of Input Sets” on the “Main” sheet of *RunSGM* and clicking on the “CtrlFile Only” button. The control file *sgmctrl.csv* will then be ready for double clicking on *SGM.exe*.

The *sgmctrl.csv* file and the various input files will be described in the next section. How they are combined to form the various scenarios listed in the “InputSets” sheet of *RunSGM* will be discussed in the input files section.

The sgmctrl.csv Control File

Lines (1) through (15) of the *sgmctrl.csv* control file are hard-coded, meaning that the SGM looks for the required file definitions and comments on the exact lines as they are given in the sample. If the path name for the “Testing File” *\Outputs\sgmout.csv* were entered on line (4) rather than on line (6), for example, the SGM would read the path name as a comment rather than as a file location. The comments on lines (1)-(4) and (9) are there for the benefit of the user only and are ignored by the SGM. The blanks lines are hard-coded. The user can specify the name of the excel output file on line (10) *Thus, the order in which and line-numbers on which the specific output file names are read are hard coded and should not be changed.*

| | |
|--|----|
| Autogen control file (SGM) | 1 |
| run label and comments (2 lines) | 2 |
| US baseline_new_C | 3 |
| e.g. date | 4 |
| ..\Outputs\sgm_us.mdb | 5 |
| ..\Outputs\SGMout.csv | 6 |
| | 7 |
| | 8 |
| **ENTER ENERGY/EMISSIONS/FINANCIAL OUTPUT FILE PATH/NAME | 9 |
| ..\Outputs\sgmgen2004_us_baseline_A.csv | 10 |
| | 11 |
| | 12 |
| | 13 |
| | 14 |
| | 15 |
| NEW_FILE | 16 |
| ..\inputs\USinputs\us_baseline_A.csv | 17 |
| | 18 |
| NEW_FILE | 19 |
| ..\inputs\paths\us_CE\$100.csv | 20 |
| | 21 |
| cNEW_FILE | 22 |
| ..\inputs\USinputs\non-CO2_MACs_US.csv | 23 |
| | 24 |
| NEW_FILE | 25 |
| ..\inputs\screen.csv | 26 |

The next section of the control file lists the input files necessary to run a particular scenario. This section of the control file begins on line (16). Unlike the Comments and Output File section described above, the Input File section of the control file is not hard coded. Instead, the SGM searches the control file beginning at line (16) for the “NEW_FILE” marker. Whenever a “NEW_FILE” marker is located in the file, as in line (16), the SGM reads the line following the marker, in this case line (17), as the path and file name of an input file for that scenario. Any paths or file names not immediately preceded by a “NEW_FILE” marker will be ignored. Lines 25 and 26 show the closing information any scenario run requires.

To deactivate or “turn off” an input file, simply change the "NEW_FILE" mark that precedes it and the model will skip over the mark and look for the next one. For example, the marker on line (22) has been altered to “cNEW_FILE” so that the file listed on line (23) will not be counted as an input file for that particular model run. The MAC file is required for the carbon-equivalent (CE) management scenarios.

Input Files provided for US Runs

| | |
|---|---|
| ..\inputs\USinputs\usa_baseline_2004_A.csv | The baseline dataset: 16 electricity generating technologies with the necessary delays for new technologies; CE emissions |
| ..\inputs\USInputs\non-CO2_MACs_US.csv | Marginal abatement cost curves for non_CO ₂ gases required for carbon-price based mitigation of CE emissions |
| ..\inputs\paths\us_CE_\$100_asof2015.csv | A carbon-equivalent price in US\$1990 when CE emissions, including CO ₂ , are mitigated |
| ..\inputs\paths\us_CE_target2005_by2015.csv | A year 2015 carbon-equivalent emission stabilization target when CE emissions, including CO ₂ , are mitigated |

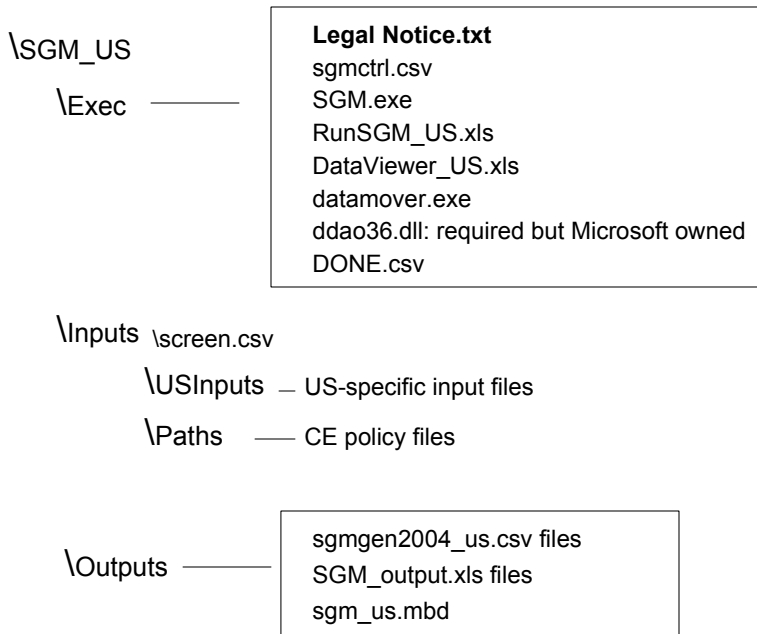
Output Files Provided for the US

| | |
|--|---|
| ..\outputs\sgmgen2004_US_CE_baseline_A.csv | This baseline excel output file is provided for Quality Control of the package. The ..\outputs\sgmgen2004_US_baseline.csv is based on the ..\inputs\USinputs\usa_baseline_2004_A.csv file |
| ..\outputs\sgm_output_US_baseline_A.xls | These workbooks allow for graphics from sgmgen2004 output files with emphasis on electricity outputs |
| ..\outputs\sgm_output_US_\$100_A.xls | |
| ..\outputs\sgm_output_US_target2005_A.xls | |

Appendix

The Directory Structure

The SGM, as provided, is designed for a directory structure as shown below:



The Exec Subdirectory

The \Exec subdirectory has to contain the following files and sub-subdirectory:

- Code: The source code will be provided in the next release. The code is not required to run the model.
- *SGM.exe*: This is the SGM executable. The user may run the model simply by double clicking the *SGM.exe* icon once a scenario has been constructed as long as the *sgmctrl.csv* file is in the same directory as the *SGM.exe* file.
- *RunSGM_US.xls* requires that the executable *SGM.exe* is in the same directory and that no *sgmctrl.csv* is open. *RunSGM.xls* is the primary user interface for setting up scenario runs. When a scenario is run by means of *RunSGM.xls* the required scenario control file *sgmctrl.csv* is generated.
- *sgmctrl.csv*: is the file that controls the operation of the SGM by specifying the input and output files to be used for a given model run.
- *DataViewer_US.xls* is the primary user interface for viewing model output.
- *Datamover.exe* moves the data to the data viewer.
- *DONE.csv* activates the moving of data to the correct output data base.

The Inputs Subdirectory

The Inputs subdirectory contains the following sub-subdirectories:

- The USInputs sub-subdirectory houses the base input files for the US and the marginal abatement cost curves for non-CO₂ greenhouse gas mitigation (*non-CO2_MACs_US.csv*).
- The Paths sub-subdirectory contains the input files that specify different carbon management options.

Input files contain tables that specify values for the variables necessary to run a scenario. Each variable table is contained in an input block that includes the table and a variable identification (ID) number that tells the SGM how that input table should be read.

Input files may contain as many or as few input blocks as desired by the user. The SGM reads the input files specified in the control file in order of their appearance in the control file. If, as the SGM proceeds through the list of input files, the model encounters multiple tables with the same variable ID number, the last table read will take precedence. *This structure makes the sequence of input blocks in the input files, and in the input files in the `sgmctrl.csv` file, extremely important.*

The Outputs Subdirectory

- The Access data base *SGM_us.mdb* found in the output subdirectory collects all output data generated with the SGM.exe file. These data can be viewed through the dataviewer.
- The output file of primary interest to most model users besides output through the dataviewer is *sgmgen2004_us.csv* which can be directly viewed as Excel spreadsheet. It contains several tables: e.g. data on greenhouse gas emissions, economic activity, energy consumption and production, and carbon management implementation by 5-year periods.
- The output workbooks *sgm_output_us.xls* allows the user to view output based on the *sgmgen2004_us.csv* output files, outside the dataviewer. The *sgmgen2004_us.csv* files generated in a scenario run can be pasted under the “sgmgen” tab in any of the *sgmgen_output_us.xls* workbooks and results regarding electricity outputs analyzed quickly. Please, carefully match the top of the output block, line (12), when pasting files. Note that three excel workbooks have been provided: the baseline case for the US, the \$100 carbon-equivalent emission case and the carbon-equivalent emission stabilization case.

Sample Scenarios

The three sample scenarios included in this package are: (1) a baseline for the United States from 1990 through 2050 in five-year time steps; (2) a carbon charge of \$100 per ton of carbon-equivalent emissions beginning in 2015 and remaining constant thereafter; and (3) returning to 2005 levels of carbon-equivalent emissions in year 2015 and holding at that level of emissions thereafter.

These scenarios are designed to illustrate a range of model capabilities; not to simulate any specific climate policy proposal. The scenarios allow a wide range of electric generating technologies to operate under carbon management alternatives.

In the emissions mitigation scenarios, one can think of four classes of mitigation options: improvements in energy transformation efficiency, including shifts among electric generating technologies; reductions in emissions of non-CO₂ greenhouse gases; introduction of CO₂ capture and storage with electric generating technologies; and terrestrial mitigation options including carbon sequestration and biofuel offsets. Two of these classes, non-CO₂ greenhouse gases and the terrestrial options, are handled in SGM through the introduction of exogenous marginal abatement cost curves. The non-CO₂ cost curves were developed by the U.S. Environmental Protection Agency for Stanford Energy Modeling Forum study 21. The terrestrial cost curves were provided by Bruce McCarl of Texas A&M University. This latter option will be included in the next release.

In the supplied scenario with a fixed carbon fee of \$100 per tC, all of the mitigation options respond to the carbon price. In the other carbon management scenario, the emissions target is the 2005 level of carbon-equivalent emissions, including the non-CO₂ greenhouse gases. The SGM calculates a carbon price for each time period to just meet the target.

Note that the *Dataviewer_US.xls* allows for model output comparisons and for verification that the user ran the example scenarios as expected. It contains all information on SGM’s carbon-equivalent emissions, production, consumption, investment, capital stock, profits, etc.

JGCRI's Software User Acknowledgement

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