

The TAF Emissions Model in Analytica: 1998 Project Summary

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This document summarizes the conversion of the TAF emissions model from Visual Basic to Analytica. Over the past year, the model has been converted, validated, and improved to provide more accurate results. The results of the emissions model for several predefined scenarios have been imported into the main TAF model, so that modelers can use these scenarios with TAF without first executing the emissions model.

The process can be divided into the following steps: Model Conversion, Model Validation, and Model Extension. Each of these steps is outlined in the following paragraphs.

Model Conversion

The Visual Basic emissions model developed at Argonne National Labs in 1996, together with the algorithm specifications for the emissions model, were used to create a version of the emissions model in Analytica. The Microsoft Access databases used by the Visual Basic model were imported into Analytica, and used without major modification in the Analytica model algorithms.

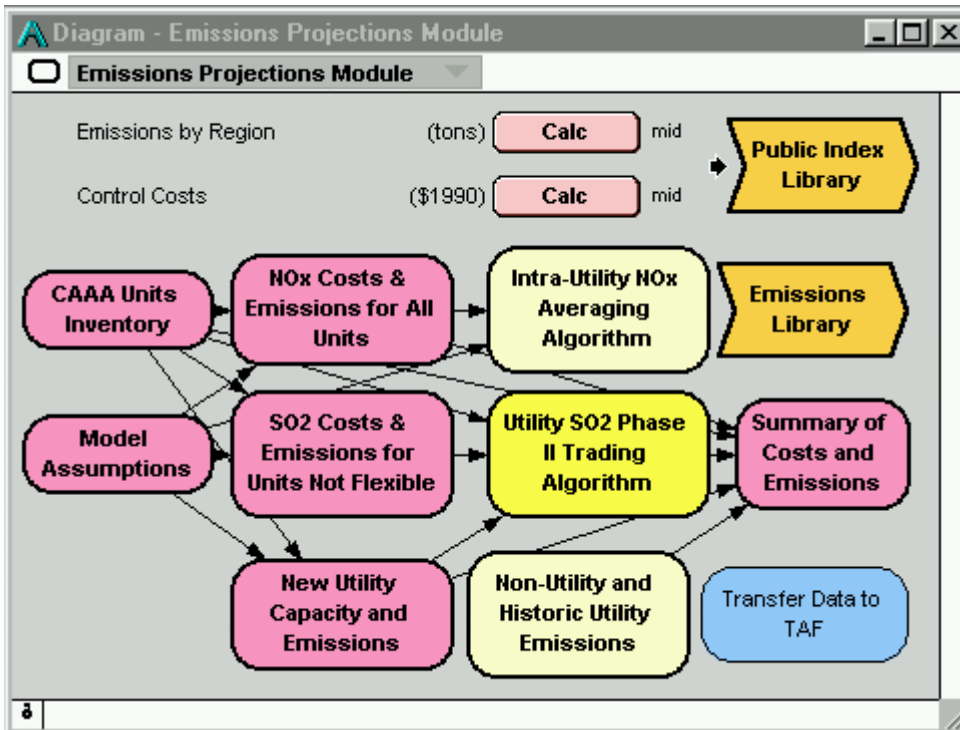


Figure 1. The TAF emissions model resides within an Analytica model, run separately from the main TAF model. Results can be easily imported from the emissions model into TAF for assessment of costs and benefits under different regulatory and utility assumptions.

Model Validation

Model validation required significant resources from both Lumina and Resources For The Future. In the process of porting the model, refinements to algorithms streamlined computation of many components, including:

- Group B NOx reduction cost accounting with and without Title IV regulation.
- Costs of scrubbing plants under aggressive regulation scenarios.
- Coal transportation cost accounting.
- Plant retirement algorithms were expanded to better approximate utility actions and were linked to plant cost accounting and amortization.
- Scrubber removal efficiencies.

The end result of this process was a pair of models, one in Visual Basic and one in Analytica, which were in almost perfect agreement.

Model Extension

Several extensions have been added to the model to study the effects of banking, as well as the scenarios included in TAF:

- Banking can be toggled on and off when the trading scenario is selected. There is a toggle for the bonus allowances since the bonus allowances do not affect the optimization under no banking.
- Annualized costs provide an alternative method of aggregating costs. The VB model calculates costs and levelizes them over the 35-year period from 1995 to 2030, regardless of when the costs are incurred; this is referred to as flat costs. The annualized costs method levelizes costs only over the lesser of the remaining years of a plant or 30 years.
- Users can opt to implement any of the TAF scenarios. Toggles were created for the Aggressive Low Sulfur Program, and New PM Standard scenarios.
- In addition, a High Technology scenario increases nuclear unit utilization, reducing the amount of new generation demanded.

Previously, the model called for units planning to scrub under phase I to use 1993 emission factors in the baseline case. Alternatively, a user can allow these units to switch or blend for economic reasons in the baseline, as is the case for all other units.

The TAF Model and the New Emissions Data

The incorporation of the new emissions data allows users of TAF to benefit from the new emissions model without enduring the extended execution times of the emissions model in Analytica (several hours). Unlike the emissions model, the TAF model executes in a few minutes on a Pentium-class computer. Thus, model users may readily explore the implications of the emissions profiles on their desktop computers. A screen shot of the TAF model regulatory scenario selector module is given below. From this module, one of seven predefined scenarios (combinations of a base regulatory case and a comparison case) may be explored. The Default Scenario and the alternatives described as deviations from the default include the following:

1. Default: a comparison of emissions with and without Title IV with Trading. Plants retire when 70 years old and electricity demand grows at 1% p.a. This scenario also includes banking, bonus allowances, 40-year nuclear plant retirement, and low coal transportation costs.
2. High Growth: assumes demand grows at 3% p.a.
3. Early Retirement: assumes plants retire when 60 years old.
4. Aggressive Low Sulfur Program: assumes coal transportation costs are lower. To operationalize this, the transportation escalation rate is changed from 0.75% and 0.5% for Eastern and Western coals to -0.8% for both. (Note that the Visual Basic version of the emission model used a single escalation rate for mine mouth coal supply and transportation. The Analytica version of the emission model breaks this out into two separate rates.) Also, the coal escalation rate was changed from 0.75% and 0.5% for Eastern and Western coals to -1.5% for both. The "Freight on Board" costs were changed from 32 and 10.86 for Eastern and Western to 28 and 9, respectively.
5. No Trading: assumes permit trading is disallowed.
6. New PM Standard: assumes a more stringent particulate matter standard is promulgated in 2005, resulting in a 50% reduction in allowances in 2005 and beyond.
7. EPA: uses the EPA sponsored emissions estimates generated by the consulting firm Hagler-Bailly. (Hagler Bailly. 1995. *Human Health Benefits Assessment of the Acid Rain Provisions of the 1990 Clean Air Act Amendments*. Prepared by Hagler Bailly Consulting, Inc., Boulder, Colorado, under subcontract to ICF Incorporated, Fairfax, Virginia, for U.S. Environmental Protection Agency, Acid Rain Division. Final Report.)

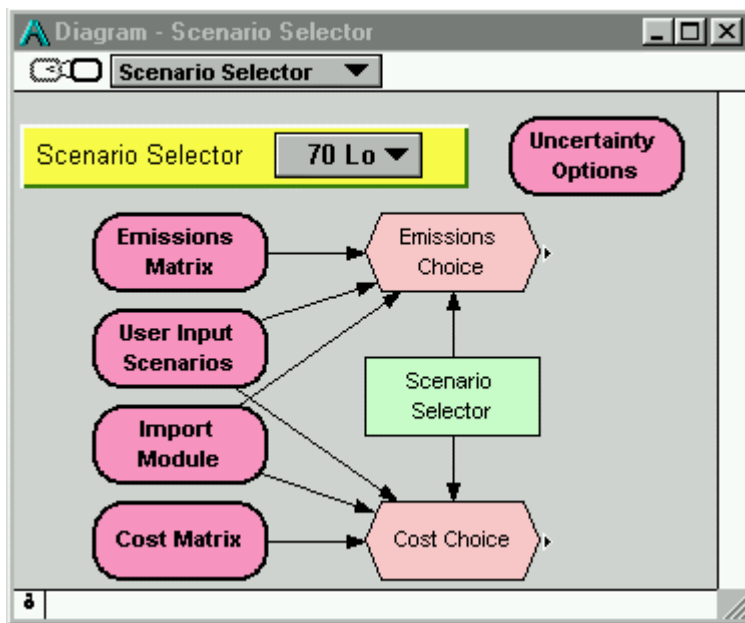


Figure 2. The Pre-Defined Scenario interface allows rapid selection of a regulatory scenario to compare against a pre-1990 Clean Air Act projection of emissions.

Users may also select the user-defined scenario case available in the original TAF model. This case allows users to develop their own emissions profiles at the national, or state level for both the base and comparison cases.

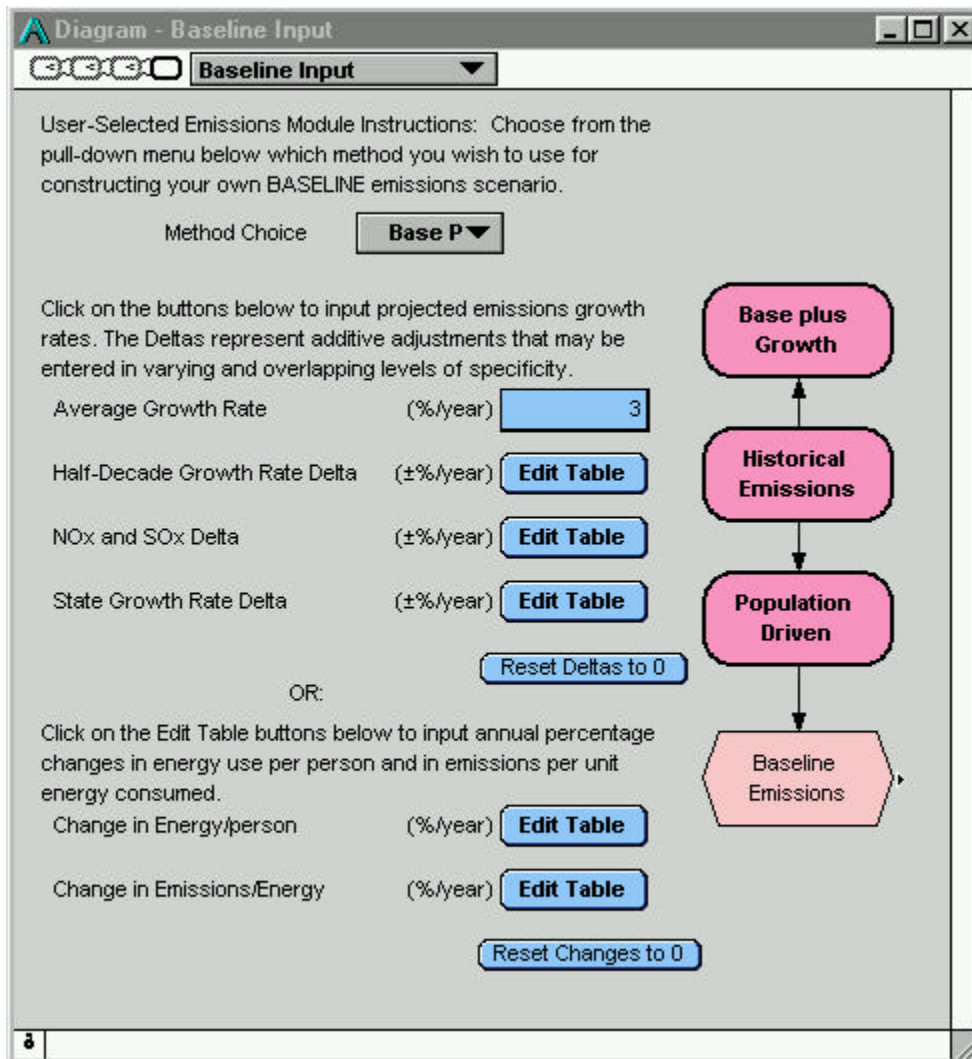


Figure 3. The User-Defined Scenario interface allows creation of custom emissions profiles in TAF.

Because the Analytica emissions model provides emissions and cost data in a form readable by the TAF model, users can also export newly created emissions scenarios from the emissions model directly into the TAF model. These data can then be utilized by the TAF model to compare costs and benefits for a custom-generated emissions and cost of abatement profile.

To export the data from the emissions model, set the emissions model input settings as desired for your model run, then request the result table for the 'Transfer' node in the emissions model, located in the 'Export' module. When the result appears, select the File/Export command from the application pull-down menus. Save the result table to a file.

Open the TAF model in another instance of Analytica. In the scenario selector module, enter the module entitled 'Import Module'. View the edit table for the node entitled 'Transfer'. Select File/Import from the application pull down menu, and select the file to which you exported the emissions data from the emissions model. Now move back to the main scenario selector screen, and select the 'imported scenario' option from the pull down menu on the diagram window. The emissions and cost profiles you generated will now be used in the TAF model calculations. Saving the TAF model will retain your custom emissions and cost profiles for use the next time you open TAF.