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Project Summary

Description of the Process Model Projection Technique (PROMPT) (Version 3.0)

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The Process Model Projection Technique (PROMPT) is one of four stationary source emission and control cost forecasting models developed by the U.S. EPA for the National Acid Precipitation Assessment Program (NAPAP). PROMPT projects air pollution emissions (SO_2, sulfates, and NO_x) and costs for industrial combustion and industrial processes (e.g., process heaters, furnaces, dryers, kilns, engines, turbines and wood-fired boilers). PROMPT excludes emissions from the combustion of natural gas, distillate or residual fuel oil or coal in industrial boilers. The outputs are provided for 1980 (from baseline data), and are forecasted for 1985, 1990, 1995, 2000, 2010, 2020 and 2030.

This document describes the model logic and data sources for PROMPT Version 3.0. The data sources used to develop Version 3.0 predate the release of the final 1980 NAPAP Emissions Inventory. Compilation errors identified and corrected in these preliminary inventory data have *not* also been corrected in the baseline data for Version 3.0. Instead, EPA has chosen to update the baseline emissions data in PROMPT using the more extensively quality assured 1985 NAPAP Emissions Inventory data base now nearing completion. Although PROMPT Version 3.0 has been tested to verify that its source code and algorithms are functioning

as intended, the reader is cautioned to remain aware that the results obtained from this version of PROMPT are expected to significantly change when the next, updated version of PROMPT using the more accurate 1985 emission inventory data in the model's baseline is released.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

This report presents the logic, structure and data used in the Process Model Projection Technique (PROMPT). PROMPT is a model developed for the U.S. EPA in cooperation with the National Acid Precipitation Assessment Program (NAPAP). By design it is a simple, low-cost model which will provide an initial assessment of the role and magnitude of industrial process emissions in the control of acid deposition sulfur oxides/nitrogen oxides (SO_x/NO_x) precursors.

PROMPT projects the emission of NO_x and SO_x from industrial sources such as process heaters, wood-fired boilers, furnaces, dryers, kilns, engines, and turbines through the year 2030. Projections of emissions from

combustion of natural gas, distillate or residual fuel oil, or coal in industrial boilers are developed through the companion Industrial Combustion Emissions (ICE) Model. In operating PROMPT (Version 3.0), the user can select one of four predetermined energy and economic scenarios and one of several alternative air pollution control strategies. The model estimates the emissions reduction and cost of the selected strategy.

Why PROMPT Was Developed

The purpose in developing PROMPT was to obtain a technique for assessing the role of industrial processes in contributing to acid deposition SO_x/NO_x precursors. At EPA's request, design goals for PROMPT included restrictions that it be easy to use, inexpensive to create and run, and readily transferable to other computer systems. To meet these goals, the model was developed with substantial aggregation of industrial emission sources and control cost information drawing on existing data bases.

What PROMPT Does

Industrial process emissions sources are aggregated into eight emission source groups for SO_x analyses and redistributed into seven other emission source groups for NO_x analyses. For each group, an aggregate emission factor has been assigned. Simple control cost functions are used with each emission source group to estimate emission reductions and control costs. Within some of the emission source groups, actual control options will vary substantially; for others, control methods have not been commercially applied. By necessity, the control cost functions are based on limited data.

PROMPT is designed to perform three functions·

1. For a selected fuel demand projection, estimate NO_x or SO_x baseline emissions (without acid deposition control initiatives).

2. Compute emissions reduction and control costs to meet a user-specified NO_x or SO_x emission control strategy.

3. Generate summary output tables of emissions and control costs.

How PROMPT Operates

The model execution steps and the required data inputs for PROMPT are described below

1. *NAPAP Energy/Economic Scenario*: The industrial fuel demand in PROMPT is derived from alternative NAPAP energy/economic scenarios data sets consisting of regional industrial production indices by SIC code for 1980 through 2030, and regional industrial energy prices through the year 2045. Three sets of driver data are utilized from NAPAP's 1985 "reference," "low," and "high" cases. A fourth case was prepared in 1986 with a "middle range" oil price case and the NAPAP 1985 low economic growth rates.

2 *ISTUM-2 Model Runs*. PROMPT uses industrial energy demand projections generated by the Industrial Sector Technology Use Model (ISTUM-2) ISTUM-2 is a process engineering model of the industrial sector that allows for technology competition at a detailed process level. Driven by the energy/economic scenarios, the model provides a forecast of the mix of fuels used by the industrial sector on a regional basis.

3. *Industrial Process Fuel Use Demand Projections*: The ISTUM-2 energy demand projections for the four cases are entered into PROMPT as permanent input data files Excluded are ISTUM-2 forecasts of natural gas, distillate fuel oil, residual fuel oil and coal demand in industrial boilers Before the data are entered, the Btus of fuel demand are aggregated into the broad categories defined as emission source groups. Emission source groups exist separately for NO_x emissions versus sources of SO_x emissions Table 1 lists the NO_x and SO_x emission source groups in PROMPT.

4. *Energy Scenario and Pollutant Selection*: To initiate a model run, the user specifies: (a) one of the four fuel demand scenarios, and (b) the pollutant to be forecasted (either NO_x or SO_x). The model performs only NO_x or SO_x emissions calculations. To project both pollutants, PROMPT must be run twice.

5 *NO_x or SO_x Uncontrolled Emissions*. For each emission source group, NO_x or SO_x emission factors are applied to the Btus of fuel demand. The emission factors generally vary by fuel type except for emission source groups that emit significant

amounts of process- rather tha fuel-related emissions. Note th SO_x emissions in two source group Smelters and Sulfur Processing, ar not derived from energy deman data. SO_x emissions originating i these two emission source group are primarily non-fuel-relatec These emissions data are a exogenous input.

6. *NO_x and SO_x Emission Factor* Uncontrolled emission factors th vary by emission source group ar fuel type have been estimated fe use in PROMPT. Controlled emissic factors have also been develope where control options are considere feasible The number of contr levels in the model varies with th emission source group.

7 *Air Pollution Control Scenar Inputs*: The model user can sele from a set of air pollution contr strategies to evaluate the potenti NO_x or SO_x emission reductions ar the resulting cost of pollution contrc The strategic options include uniform percent reduction for eac emission source group, a unifor emissions limit, an aggrega percent or amount of reduction, ar control to a specified level of co effectiveness (annualized co increase per unit of emissic reduction)

8 *Air Pollution Control Strateg Analysis*: PROMPT computes th potential emission reductions ar control costs for the strateg selected by the model user F certain control strategies th requires the iterative analysis of th most cost-effective control optioi for several emission source grour If no control strategy is selected, th part of PROMPT is by-passed

9. *Emission and Control Cost Outpu* NO_x or SO_2 emissions, plus ; pollution control costs for a select control strategy, are provided at regional level, by emission sour group and disaggregated to State-level in a data file consiste with the input requirements another NAPAP model. Prima sulfate emissions are also comput by State and by region, assumi that 2% of SO_2 emissions are em ted as sulfates The emission/cc outputs are generated for 1980 (ba year), 1985 (projected, not actui 1990, 1995, 2000, 2010, 2020, a 2030.

Table 1. PROMPT Emission Source Groups

Pollutant	Group	Emission Source Group
SO_x	1	Smelters[a]
	2	Coke ovens
	3	Cement kilns
	4	Pulp liquor recovery
	5	Sulfur processing[a]
	6	Petroleum cracking
	7	Agglomeration
	8	Other fuel uses not covered above[b]
NO_x	9	Process heaters with high temperature recuperators
	10	Process heaters with low temperature recuperators
	11	Glass melting
	12	Cement kilns
	13	Turbines and engines
	14	Fluid bed combustors[c]
	15	Other fuel uses not covered above[d]

[a] Based on exogenous assumptions; not generated in PROMPT using fuel demand dependent emission factors.
[b] Includes refinery heaters, steel reheat furnaces, soaking pits, drying operations, glass manufacturing, and industrial turbines.
[c] Fluid heating, not steam generation
[d] Includes process heaters without preheat devices, such as brick furnaces, chemical heaters, and low temperature dryers (e.g., food plants); coke ovens; pulp/paper recovery burners; and secondary steel mills.

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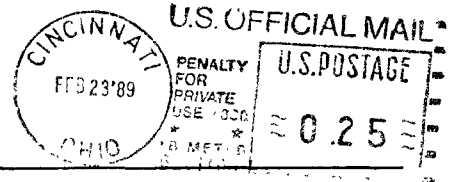
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