



CONTROL STRATEGY TOOL (CoST)

GLOSSARY

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Acronyms

AQM	air quality model
CE	control efficiency
CMAQ	Community Multiscale Air Quality model
CMAS	Community Modeling and Analysis System
CMDB	Control Measures Database
CoST	Control Strategy Tool
CRF	capital recovery factor
CSV	comma-separated values
DBF	database format
EMF	Emissions Modeling Framework
EPA	U.S. Environmental Protection Agency
ESRI	Environmental Systems Research Institute (creators of ArcGIS software)
FIPS	Federal Information Processing Standards
FGD	Flue Gas Desulfurizer
GIS	geographic information system
HAP	hazardous air pollutant
IE	Institute for the Environment (UNC)
LNB	low NO _x burner
NAICS	North American Industry Classification System
NEI	National Emissions Inventory
O&M	operating and maintenance
ORL	one record per line
PR	percent reduction
RE	rule effectiveness
RP	rule penetration
SCC	Source Classification Code
SIC	Standard Industrial Classification
SQL	Structured Query Language
SMOKE	Sparse Matrix Operator Kernel Emissions modeling system
UNC	University of North Carolina

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1 Introduction

The U.S. Environmental Protection Agency (EPA) Health and Environmental Impacts Division (HEID) is developing the Control Strategy Tool (CoST) to support national- and regional-scale multipollutant air quality modeling analyses. CoST allows users to estimate the emission reductions and costs associated with future-year emission control strategies, and then to generate emissions inventories that reflect the effects of applying the control strategies. The emissions reductions achieved by control strategies are due to the application of control measures to emissions sources. Control measures are devices or techniques that reduce emissions for at least one pollutant of interest for a particular group of emissions sources. CoST tracks information about control measures, their costs, and the types of emissions sources to which they apply. This tool helps users develop control strategies that match control measures to emission sources using the available algorithms such as “Maximum Emissions Reduction”, “Least Cost”, and “Apply Measures in Series” (these terms are explained in Section 4.1). CoST is a component of the Emissions Modeling Framework (EMF), which is currently being used by EPA to solve many of the long-standing complexities of emissions modeling.

This document provides a glossary that defines terms used in the document series for the CoST software. For additional information on CoST, please see the following independent documents:

“Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation”

“Control Strategy Tool (CoST) Development Documentation”

“Control Strategy Tool (CoST) Cost Equations Documentation”

These documents, and additional information about CoST, can be found at:

<http://www.epa.gov/ttn/ecas/cost.htm>.

2 Glossary of Terms

Abbreviation: A shorthand set of 10 or 16 characters used to uniquely identify a control measure. Each control measure used in CoST must have a unique abbreviation.

Annotate Inventory: An algorithm to develop a control strategy that assigns control measures to an emissions inventory based on the specified control efficiency for each source. This algorithm can also be used to fill in control measure information for inventory sources that are missing details on the actual control measures used, but have a control efficiency assigned. (This algorithm could be applied to either a base- or future-year inventory.).

Annual Cost: The total annual cost (including both capital and operating and maintenance) required to keep a control measure on a source for a year. This is a column found in the Strategy Detailed Result table for a control strategy.

Annual Operating and Maintenance (O&M) Cost: The annual cost to operate and maintain the measure once it has been installed on the source. This is a column found in the Strategy Detailed Result table for a control strategy.

Annualized Capital Cost: The annualized cost of installing a control measure on a source, assuming a particular discount rate and equipment life. This is a column found in the Strategy Detailed Result table output by CoST for a given control strategy.

- Annualized Cost per Ton:** The annual cost divided by the emission reduction achieved by a control measure. This is a column found in the Strategy Detailed Result table for a control strategy.
- Apply Measures In Series:** An algorithm to develop a control strategy that assigns all control measures that can be used for a source to that source in the specified order. This algorithm is often used for mobile sources, for which the control measures are often independent of one another.
- Capital Cost:** The total cost to install a control measure on a source. Often, the capital cost is paid for by amortizing the cost over the life of the installed the equipment.
- Capital Recovery Factor (CRF):** A formula used to amortize the capital cost into the annualized capital component that is part of the annualized cost estimate for a control measure. The formula is $1/(1+i)^n$, where i = discount or interest rate, and n = equipment life.
- Class [of Control Measure]:** Characterizes the status of a control measure. Currently available classes are Emerging (feasible, but not currently in wide use), Hypothetical (a truly made-up control used for sensitivity runs), Known (known to be currently deployed in the field), and Obsolete (used in older installations, but should not be used when performing new runs).
- Cobenefits:** Reductions to pollutants emitted at a source other than the target pollutant that occur when a control measure is applied to the source.
- Co-impact Pollutants:** Pollutants other than the target pollutant that are impacted by applying a control measure – the impacts may be benefits (i.e., emissions reductions) or disbenefits (i.e., emissions increases).
- Completion Date:** The date and time on which the strategy run was most recently completed.
- Control Efficiency (CE):** The amount of pollutant emission reduction (in percentage terms) that a control measure applied to a source is capable of when operating. This does not account for rule penetration and rule effectiveness. A positive control efficiency reflects a reduction in pollutant emissions; a negative efficiency reflects an increase in emissions.
- Control Measure:** A technique for reducing emissions for a set of emissions sources, such as a control device that goes on a stack, or a commuter program to encourage carpooling.
- Control Program:** A set of control measures and other adjustments (e.g., projection factors) that are used to estimate the effects of implementing a regulation that is “on the books” and are therefore considered when projecting a base-year emissions inventory to a future-year base emissions inventory.
- Control Strategy:** A set of control measures applied to emission inventory sources in a specified geographic region, in addition to any controls that are already in place, to accomplish a certain goal.
- Controlled Emissions Inventory:** A dataset that can be created (if desired) from a control strategy that has been successfully run. It contains a complete emissions inventory derived from the emissions inventory input to the strategy merged with the sources that were controlled by the strategy. The records in the controlled inventory include information about the control measures that have been applied to the sources and the costs to apply these measures.
- Cost Equation:** A formula used to compute the cost of applying a control measure to an emissions source. Typically the cost equation specifies the total of capital costs along with operating and maintenance costs.
- Cost Per Ton Value:** The average cost to reduce a ton of emissions of a specific pollutant. If a cost equation is not available for a specific control measure-source combination, an estimated cost per ton is used to approximate the cost for the source. The cost per ton includes both capital and operating and maintenance costs.

Cost per Ton: The cost (in dollars) required to remove one ton of a pollutant from emissions of a given source. Typically this is an overall annualized cost per ton and can be broken down into a capital cost and an operating and maintenance cost.

Cost Year: The cost year to use for the results of the strategy. All cost data specified for the control measures will be converted to this year using the Gross Domestic Product (GDP) Implicit Price Deflator.

County Dataset Version: If a county dataset is specified, a version of the dataset to use must be selected. This input is required because the EMF can store multiple versions of datasets.

County Dataset: An attribute of a strategy that gives a specific list of counties within which to apply control measures during the strategy run. Control measures will be applied only to counties that are included in this list. The system will show as options the names of the available EMF datasets that have the dataset type 'List of Counties (CSV)'. When importing one of these datasets, the CSV file must have at least two columns, the first row of which is the column names. One of the columns must have a name that starts with "FIPS". CoST will assume this column has the list of FIPS codes that should be controlled. Leading zeros should be present for FIPS codes less than 10000.

Creator: The name of the person who created a control strategy or control measure.

Dataset: A table of data stored within the Emissions Modeling Framework (EMF). In addition to the data themselves, datasets have many metadata attributes and can have multiple versions.

Disbenefit: an increase in emissions of a pollutant that results when a control measure aimed at reducing another pollutant is applied to a source.

Discount Rate: The discount (i.e., interest) rate used to compute the capital recovery factor, which is used to compute the annualized capital cost for control measures whose costs can be estimated using cost equations.

Effective Date: The date on which the efficiency record becomes applicable. If a control measure is phased in over time, multiple efficiency records can be specified with different dates to reflect the impact of the phase-in.

Efficiency Record: Part of a control measure that specifies the impact of a measure for a specific pollutant, locale, effective date, and range of emissions values.

Emerging Control Measure: A class of control measure that has not frequently been deployed to-date, but is expected to come into use in future years. Cost and control efficiency data for emerging measures may be more uncertain than those for known measures.

Emissions Inventory: A dataset that contains emissions data for multiple emissions sources and often multiple pollutants. A control strategy operates on one or more emissions inventories.

Emissions Modeling Framework (EMF): a client-server computer software system developed by the EPA to manage data related to emissions modeling and runs of emissions models.

Equipment Life: The expected lifetime of a control measure (in years).

Filter: Criterion used to narrow the data elements that are used for an analysis or are shown on the screen (e.g., a filter could specify a subset of an emissions inventory to use in an analysis, or a subset of control measures to consider).

FIPS Code: a five digit code used by the Federal Information Processing System that uniquely identifies a state or county.

Foreign Key: In the context of relational databases, a foreign key is a referential constraint between two tables. The foreign key identifies a column or a set of columns in one (referencing) table that refers to a column or set of columns in another (referenced) table.

Hypothetical Control Measure: A class of control measure that is not necessarily realistic, but has been added to the system to perform a sensitivity analysis related to what level of emissions reduction could be achieved *if* a measure were available with the specified control strategy parameters.

Inventories: The emissions inventories for which the control strategy will be run. The inventories must have been loaded into the EMF and have one of the following EMF dataset types: ORL point, ORL nonpoint, ORL nonroad, or ORL onroad. Multiple inventories can be processed for a strategy. Note that multiple versions of the inventories may be available, and the appropriate version of each inventory must be selected prior to running a control strategy.

Inventory Filter: An attribute of a strategy that specifies a general filter that can be entered using the same syntax as a SQL “where” clause. Any of the columns in the inventory can be used in the expression. Examples include: “SCC like ‘212%’ ” to limit the analysis to apply only to inventory records for which the SCC code starts with 212, and “FIPS like ‘06%’ or FIPS like ‘07%’ ” to limit the strategy analysis to apply only to inventory records with FIPS codes starting with 06 or 07.

Known Control Measure: A class of control measure to be used for measures that have actually been deployed and demonstrated in some installation, which means the control strategy parameters are known.

Last Modified Date: The date and time when the strategy was last modified.

Least Cost Curve: An algorithm to develop a control strategy that iteratively performs least-cost runs at multiple percentage reductions so that a cost curve can be developed that shows how the annualized cost increases as the level of desired reduction increases.

Least Cost: An algorithm to develop a control strategy that assigns measures to various sources to achieve a specified percentage or absolute reduction in emissions within a region with the minimum possible annualized cost. Note that each source is assigned a single measure when using this algorithm.

Locale: Part of a control measure efficiency record that can limit the applicability of the record to a specific county by using a full five-digit FIPS state and county code, or to a state by using a two-digit FIPS state code. If no entry is given, it applies generally to any source. This allows control efficiency, rule effectiveness, rule penetration, and cost to vary by county or state.

Maximum Annualized Cost (\$/yr): A constraint for a control strategy that requires each control measure to have an annualized cost less than the specified annualized cost for each source (down to the stack+segment level) and target pollutant. This cost is currently based on 2006 dollars.

Maximum Cost Per Ton (\$/ton): A constraint for a control strategy that requires each control measure to have an annualized cost per ton less than specified maximum annualized cost per ton for each source and target pollutant. This cost is currently based on 2006 dollars.

Maximum Emissions Reduction: An algorithm to develop a control strategy that assigns to each source the single measure that provides the maximum reduction to the target pollutant, regardless of cost.

Measure Classes To Include: A list of measure classes from which to include control measures to be used as part of a control strategy. Currently available classes are Emerging, Hypothetical, Known, and Obsolete (see definition for “Class of Control Measure”).

Measures To Include: A list of specific control measures to consider using for the strategy run. Measures with similar names may be selected as a group. When measures to include are chosen this way, it is possible to specify a County Dataset that lists the counties in which each measure may be

applied, along with a County Dataset Version. The relative order of measure application may be specified (i.e., for the “Apply Measures in Series” strategy type). In addition, override values for the rule penetration and rule effectiveness may be specified.

Merge Inventories: An attribute of a control strategy that specifies whether all inventory data should be merged together prior to applying the strategy algorithm (such as might be desirable for a least-cost strategy running across multiple sectors), or whether each inventory is to be processed independently to create separate independent results.

Minimum Control Efficiency (%): A constraint for a control strategy that requires each control measure used in the strategy to have a control efficiency greater than the specified control efficiency for a particular source and target pollutant.

Minimum Emissions Reduction (tons): A constraint for a control strategy that requires each control measure to reduce the target pollutant by the specified minimum tonnage for a particular source (down to the plant+point+stack+segment level of specification). Measures that do not result in the minimum reduction for that source will not be applied.

Minimum Percent Reduction Difference for Replacement Control (%): A constraint for a control strategy that requires each assigned control measure to cause a percent reduction in emissions greater than the specified value in order for the old control measure to be “replaced by” the new control measure, according to the formula:

$(\text{original emissions} - \text{new emissions}) * 100 / \text{original emissions} > \text{min. percent red. diff.}$

For example, by expressing the requirement in this way, it would allow a control with 99.9% efficiency to replace one with 99% efficiency. Note that incremental controls that add an additional device onto a previously controlled source are not yet supported by CoST, except for the Apply Measures in Series strategy type, for which all controls are assumed to be independently applicable. In the event that a combination of two control devices is listed as a control measure (e.g., low NO_x burner [LNB] + flue gas recirculation [FGR]) and provides an appropriate level of emissions reduction, that combination control measure can serve as a replacement control for the original measure.

NAICS: North American Industry Classification System. This is a system that classifies facilities and firms by industry using a two-digit to a six-digit code. This is the official industrial classification system for U.S. firms and is maintained by the U.S. Census Bureau.

Name: Each control strategy is given a unique name, as is each control measure. Each name should be explanatory to those reading it regarding the contents of the strategy or the type of measure.

Obsolete Control Measure: A class of control measure that may exist on some historical installations but is not likely to be used again in new installations, and so should not be used when performing new runs.

Operating and Maintenance Cost: The costs associated with operation and maintenance of a control measure. These costs are annual and typically vary with the level of emissions output from the controlled source. Examples of operating and maintenance costs include labor, energy, and materials replacement.

ORL (One Record per Line): A type of emissions inventory format used as input to SMOKE that has one record / pollutant per line instead of multiple pollutants on a single line. This format is used today instead of older formats due to the large HAP inventories that can have hundreds of pollutants. There are several different types of ORL formats, including point, nonpoint, nonroad mobile, and onroad mobile. The point inventories contain information about sources with specific locations

specified as latitude and longitude. Nonpoint, nonroad, and onroad inventories contain data aggregated to the county level.

Parameter: A setting that controls how a control strategy is run, such as the selection of the target pollutant or the cost year. The term parameter is also used in the context of cost equations. In that context, it means one of the numeric values used as an input to the cost equation.

Percentage Reduction (PR): The percentage by which the emissions of a source are reduced by a control measure when the control efficiency (CE), rule effectiveness (RE), and rule penetration (RP) are considered. $\text{Percentage reduction} = \text{CE} \times \text{RE}/100 \times \text{RP}/100$.

Pollutant (POLL): A compound in the air that has an impact on air quality. This is a general term and does not imply a criteria air pollutant, a hazardous air pollutant, or a greenhouse gas. Mode-specific pollutants for mobile sources are also considered pollutants (e.g., BRK__PM10 for PM₁₀ emitted from vehicle braking).

Primary Key: In relational database design, a primary key is a column or set of columns whose contents uniquely identify each row in a table. No two distinct rows in the table can have the same value (or combination of values) for the primary key.

Project Future-Year Inventory: An algorithm to develop a control strategy that applies control programs to sources, as would be needed to project a base-year inventory to a future-year inventory.

Project: An attribute of a control strategy that represents the name given to a set of analyses to be performed.

Region: The name of the geographic region to which the control strategy is to be applied. This is for user information only and does not impact the strategy results in any way. This is different from the concept of “Locale” used in the control measure efficiency records to indicate the state or county code to which the record applies. See “Control Strategy Tool (CoST) Control Measures Database (CMDB) Documentation” for more information on the use of Locale.

Rule Effectiveness (RE): The ability of a regulatory program to achieve all the emissions reductions that could have been achieved by full compliance with the applicable regulations at all sources at all times. A rule effectiveness of 100% means that all sources are fully complying at all times.

Rule Penetration (RP): The percent of sources that are required to implement the control measure. Rule penetration might vary over time as a new rule is “phased in” gradually.

Run Status: This specifies the status of the strategy run as either “Not started”, “Running”, “Waiting”, “Completed”, or “Failed”.

SMOKE: The Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system is used to process emissions inventories into data suitable for use as input to an air quality model (AQM). For more information, see <http://www.smoke-model.org>. Typically the processed inventory data have hourly time steps, are allocated onto the two-dimensional grid to be used by the AQM, and use chemical species that are compatible with the planned configuration of the AQM. Depending on the requirements of the AQM, the AQM-ready emissions data may be two-dimensional in one layer, or they may be three-dimensional to account for plume rise.

Source Classification Code (SCC): A code used to identify the type of source that created emissions. There are over 11,000 SCCs used in current U.S. emission inventories.

Start Date: The date and time on which the strategy run was most recently started.

Strategy County Summary: A dataset output from a control strategy that is a table of emission reduction and cost values aggregated by sector, county, and pollutant. Note that both uncontrolled and controlled sources are included in the summary of county-level emissions.

Strategy Detailed Result: A dataset output from a control strategy that contains a table of emission source-control measure pairings, each of which contains information about the cost and emission reduction achieved once the measure is applied to the source. Note that only controlled sources are included in the emissions given in this summary.

Strategy Measure Summary: A dataset output from a control strategy that is a table of emission reduction and cost values aggregated by the inventory sector, FIPS code, SCC, pollutant, and control measure.

Target Pollutant Reduction: The absolute emissions reduction achieved for the target pollutant.

Target Pollutant: An attribute of the control strategy that specifies the pollutant that is targeted as the primary interest for reduction in this control strategy. The least cost and maximum emissions reduction algorithms will consider reductions of this pollutant when performing their computations

Target Year: An attribute of the control strategy that specifies the target year for the strategy run. Typically, this is the year represented by the input inventory or inventories. For the “Project Future Year Inventory” analysis type, the target year represents the future year to which you are projecting the inventory. For control measure efficiency records to be considered for a strategy, the specified effective date for the record must be equal to or earlier than the target year, or the effective date may be unspecified to indicate that it is relevant to any year.

Total Annualized Cost: The annual cost associated with a control measure including capital, operating, and maintenance components. This cost reflects the cost impact associated with capital recovery.

Total Capital Cost: The total cost of installing a control measure. This cost includes all materials, equipment, labor, and land associated with control measure installation, and it includes overhead, insurance, taxes, and administrative costs.

Type of Analysis: An attribute of a control strategy that specifies the type of algorithm used to match the control measures with sources (e.g., maximum emissions reduction, least cost).

Use Cost Equations: This control strategy attribute indicates whether cost equations should be used to compute the cost of applying measures to sources. If this is not selected, or if insufficient data exist to use a cost equation, only the default cost per ton values will be used.

Where Clause: the end of a SQL query that limits which records are included, that begins with the term “where” (e.g., select * from inventory *where* POLL='NOX' and ANN_EMIS>100).