

BEN USER'S MANUAL

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THIS MANUAL IS RELEASABLE IN ITS ENTIRETY

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MAILING LIST ADDITION

If you would like to receive updated materials, and you work for a federal, state or local government environmental agency, please e-mail your name, government mailing address, and government phone number to benabel@indecon.com. If you have any questions about updates, contact the EPA enforcement economics toll-free helpline at 888-ECON-SPT (326-6778).

If you are a member of the public and would like to obtain these materials, download them from the U.S. EPA's web site at <http://es.epa.gov/oeca>. (This address may have changed by the time you read this manual. To obtain the current address, you can call the helpline at 888-ECON-SPT.)

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A. OVERVIEW

The U.S. Environmental Protection Agency developed the BEN computer model to calculate the economic benefit a violator derives from delaying and/or avoiding compliance with environmental statutes. EPA uses the model to assist its staff in developing settlement penalty figures. BEN can also develop testimony for trial or hearings, but an expert is necessary to explain its methodology and calculations. While the primary purpose of the BEN model is to calculate the economic benefit of noncompliance, the model can also calculate the after-tax net present value of supplemental environmental projects (SEP's) that involve early compliance.¹ For all other SEP's, you should use the PROJECT model.

Calculating economic benefit using the BEN model is generally the first step in developing a civil penalty figure under EPA's February 16, 1984, generic penalty policy. This two part document was codified in the General Enforcement Policy Compendium as P.T. 1-1 and P.T. 1-2. Related medium-specific policies have been developed since then to implement the 1984 policy. The BEN model assists in fulfilling one of the main goals of the generic policy. That goal is that civil penalties should at least recover the economic benefit from noncompliance to ensure that members of the regulated community have a strong economic incentive to comply with environmental laws on time. You can use BEN in all cases to measure benefit from delayed and/or avoided compliance, except for Clean Air Act Section 120 actions, which require the application of a Section 120 specific computer model.

¹ As a form of SEP, a defendant may offer to comply with an environmental regulation significantly earlier than is required. Such a SEP has associated with it an after-tax net present value that is the maximum amount by which you can reduce the proposed civil penalty. For the "compliance date" in the BEN model, enter the date when the regulation requires compliance of the defendant (i.e., the date by which you would normally expect the defendant to achieve compliance). For BEN's "noncompliance date," enter the date that the defendant is proposing for its early compliance (i.e., a date earlier than the compliance date you previously entered). Enter all other inputs normally. BEN's "economic benefit" result is the maximum amount by which you should mitigate the proposed civil penalty.

BEN is easy to use, and designed for people with no background in economics or financial analysis. Because the program contains standard values for many of the variables needed to calculate economic benefit, BEN requires only a small number of user inputs. BEN also allows the user to modify all of its standard values. Data requirements, standard values and modifications are described in detail in Chapter 3.

B. CONTEXT AND THEORY OF ECONOMIC BENEFIT

Compliance with environmental regulations usually requires a commitment of financial resources; both initially (in the form of a capital investment or one-time nondepreciable expenditure) and over time (in the form of annually recurring costs). These expenditures might result in better protection of public health or environmental quality, but are unlikely to yield any direct financial return.

Economic benefit represents the financial gains that a violator accrues by delaying and/or avoiding such pollution control expenditures. Funds not spent on environmental compliance are available for other profit-making activities or, alternatively, a defendant avoids the costs associated with obtaining additional funds for environmental compliance. (This concept is known in economics as opportunity cost.) Economic benefit calculates the amount by which a defendant is financially better off from not having complied with environmental requirements in a timely manner. Economic benefit is “no fault” in nature. A defendant need not have deliberately chosen to delay compliance (for financial or any other reasons), or in fact even have been aware of its noncompliance, for it to have accrued the economic benefit of noncompliance.

The appropriate economic benefit calculation should represent the amount of money that would make the violator indifferent between compliance and noncompliance. If the enforcement agency fails to recover through a civil penalty at least this economic benefit, then the violator will retain a gain. Because of the precedent of this retained gain, other regulated companies may see an economic advantage in similar noncompliance, and the penalty will fail to deter potential violators. Economic benefit does not represent compensation to the enforcement agency as in a typical “damages” calculation for a tort case, but instead is the minimum amount by which the violator must be penalized so as to return it to the position it would have been in had it complied on time.

C. SUMMARY OF BEN METHODOLOGY

BEN calculates the economic benefits gained from delaying and avoiding required environmental expenditures. Such expenditures can include: (1) Capital investments (e.g., pollution control equipment), (2) One-time nondepreciable expenditures (e.g., setting up a reporting system, or acquiring land), (3) Annually recurring costs (e.g., operating and maintenance costs). Each of these expenditures can be either delayed or avoided. BEN’s baseline assumption is that capital investments and one-time nondepreciable expenditures are merely delayed over the period of

noncompliance, whereas annual costs are avoided entirely over this period. BEN does allow you, however, to analyze any combination of delayed and avoided expenditures.

The economic benefit calculation must incorporate the economic concept of the “time value of money.” Stated simply, a dollar today is worth more than a dollar tomorrow, because you can invest today’s dollar to start earning a return immediately. Thus, the further in the future the dollar is, the less it is worth in “present-value” terms. Similarly, the greater the time value of money (i.e., the greater the “discount” or “compound” rate used to derive the present value), the lower the present value of future costs.

To calculate a violator’s economic benefit, BEN uses standard financial cash flow and net present value analysis techniques, based on modern and generally accepted financial principles. First, BEN calculates the costs of complying on-time and of complying late, adjusted for inflation and tax deductibility. To compare the on-time and delayed compliance costs in a common measure, BEN calculates the present value of both streams of costs, or “cash flows,” as of the date of initial noncompliance. BEN derives these values by discounting the annual cash flows at an average of the cost of capital throughout this time period.

BEN can then subtract the delayed-case present value from the on-time-case present value to determine the initial economic benefit as of the noncompliance date. Finally, BEN compounds this initial economic benefit forward to the penalty payment date at the same cost of capital to determine the final economic benefit of noncompliance.

A violator may gain illegal competitive advantages in addition to the usual benefits of noncompliance. These may be substantial benefits, but they are beyond the capability of BEN or any computer program to assess. Instead BEN asks you a series of questions about possible illegal competitive advantages so that you may identify cases where they are relevant. EPA is in the process of developing guidance protocols for such situations. You can obtain a copy of these protocols from EPA’s enforcement economics toll-free helpline at 888-ECON-SPT. Meanwhile, if illegal competitive advantage is an issue you should consult an expert or the helpline.

D. HOW TO USE THIS MANUAL

This manual provides instructions for accessing, operating and interpreting results from the BEN program. It also takes you step by step through a BEN case.

Chapter 2 outlines the procedures for installing and managing the model. Chapter 3 describes BEN’s data requirements, default values and opportunities for customization. Chapter 4 addresses common issues that arise when using BEN. Appendix A contains a detailed discussion of the economic rationale and computational methods used in BEN. You do not have to be familiar with Appendix A to use BEN or this manual.

All of the information from this manual except Appendix A is available through BEN's on-line help system. The help system is context sensitive and may be accessed at anytime during the program by pressing F1. It may also be accessed using the Help pull-down menu on the main screen.

If you are a government employee (of any federal, state or local agency) and need further assistance in operating the program or understanding the results, please contact the EPA enforcement economics toll-free helpline at 888-ECON-SPT (326-6778) or benabel@indecon.com. If you need legal or policy guidance, please contact Jonathan Libber, the BEN/ABEL coordinator at 202-564-6102, or e-mail him at libber.jonathan@epamail.epa.gov.

BEN is an interactive computer program that runs in the Windows™ operating environment. You can obtain a copy of BEN from EPA's web site (<http://es.epa.gov/oeca>).² If you lack Internet access and are a government employee (federal, state, or local), you can contact EPA's enforcement economics toll-free helpline (888-ECON-SPT, or 888-326-6778).

Chapter 2 contains five sections describing procedures for using BEN. Section A describes the structure of the computer program. Section B explains the procedures for installing the program on your computer. Section C provides data format requirements and additional helpful hints for entering data at your computer, as well an overview of error messages. Section D tells you how to calculate and print results. Section E explains how to exit the program and save files. For an in-depth description of each variable and recommended sources of information, see Chapter 3.

A. STRUCTURE OF THE COMPUTER PROGRAM

BEN consists of five different screens: main/case screen, run screen, options screen, specific cost estimates screen, and results screen. In general, you start with the case screen, enter data on separate screens, return to the case screen, then view (and print) your output on the results screen. BEN operates like any standard Windows™ application. Use the mouse or the Tab and Return keys to move between cells and within a screen. Hold down the Shift key while pressing Tab to return to previous entries.

When you first open BEN the case screen appears. BEN starts up with a blank case screen. You can obtain a new screen at any time by selecting "New" from the File menu, or using the Ctrl+N shortcut. To toggle between cases, select the appropriate file name under the "Window" menu.

² This address may have changed by the time you read this manual. To obtain the current address, you can call the helpline at 888-ECONSPT.

The first inputs on the case screen are case name, analyst name and office/agency. These values are for reference only and do not affect the results. Then BEN asks for the violator's tax status and state. With this information BEN references an internal database and automatically calculates the relevant marginal tax rates. Here you have the opportunity to modify taxes by pressing the [**Customize Taxes**] button. Under taxes is the [**Competitive Advantage**] button. Pressing this button presents you with questions to alert you to the presence of illegal competitive advantage. At the bottom of the screen, BEN requires you to enter the penalty payment date.

The right side of the case screen is for run management. Here you can create a new run, enter or edit run data, copy a run, remove a run, and calculate a run. You can create multiple runs for each case.

The run screen is where you enter the costs of compliance. You must enter all the cost data and cost estimate dates for a run before you can calculate economic benefit.

From the run screen you may go to the options screen. The option screen allows you to change BEN's standard values for the discount/compound rate and inflation. Here you can also alter the number of replacement cycles, useful life for capital equipment, whether a cost is delayed or avoided, and tax deductibility of one-time nondepreciable expenditures. This screen contains BEN's default settings, so you will never need to use it unless you customize the standard values.

From the options screen you may go to the specific cost estimates screen. This screen is needed only under certain rare circumstances. Here you can adjust BEN's assessment of on-time and delay compliance costs.

The result screen is reached from the main screen, and displays the results of BEN's calculation. Here you have three options: you can print out a summary of the BEN calculation, you can print out a detailed version of the calculation, and/or you can return to the run screen.

Once you are finished with a calculation, you can create, edit or calculate other runs. You can even create other case files, and toggle between them. Before you exit BEN it gives you the option of saving the current case, plus you can save your case file at anytime during your session. The case is saved with a ".ben" extension in the folder you specify, and all runs are automatically saved with the case.

At any time during your use of the model you can access the context-sensitive help system by pressing the F1 key, just as in any Windows application.

B. INSTALLING BEN

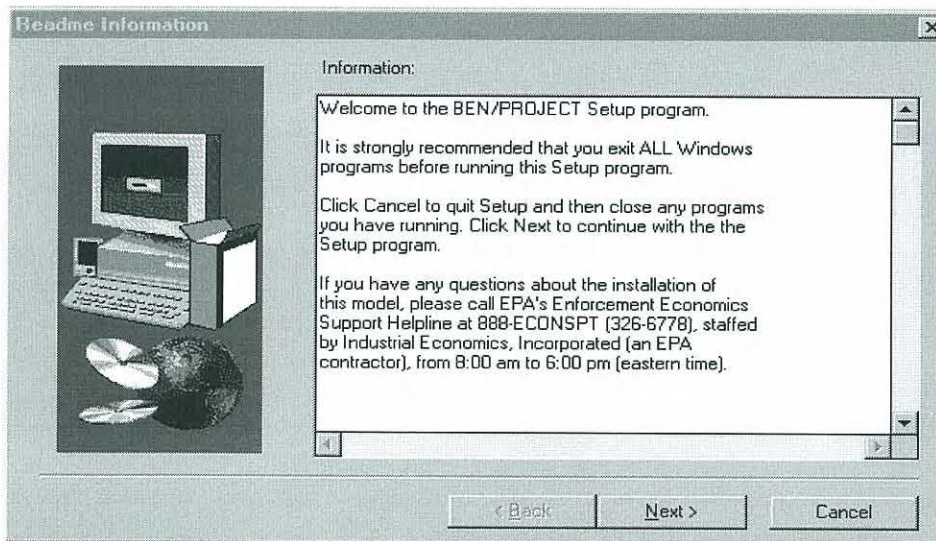
BEN requires a personal computer running the Windows operating system (Windows 95 or higher). In addition, for optimal formatting of various data entry screens, set your display in the control panel to “small fonts” option. (“Small fonts” is the Windows default, so unless your display settings have been altered, your computer should be set appropriately.)

The remainder of this section describes how to install BEN from EPA’s website or from floppy disks onto a local network or stand-alone PC. Installing BEN will automatically install the PROJECT model, since the models share some installation files. If you have trouble downloading or installing the model, consult your local computer technician.

BEN is located on the EPA website at <http://es.epa.gov/oeca>.³ To install BEN, first download the installation file to your computer or network, then run the file and follow the steps listed below for installing it from a set of disks. The installation screens will appear as they do for installation from a disk, although you will not be prompted for a second disk.

If you have access to the installation disks, insert Disk 1 and run “a:\setup.exe” (or “b:\setup.exe” if the floppy is in the b:\ drive). Then click [OK]. If you receive a warning message that you cannot copy a file because it is in use, simply click [OK]. It is merely notifying you that the file the installation system is trying to copy already exists on your computer and is currently open.

The first BEN setup screen will appear:

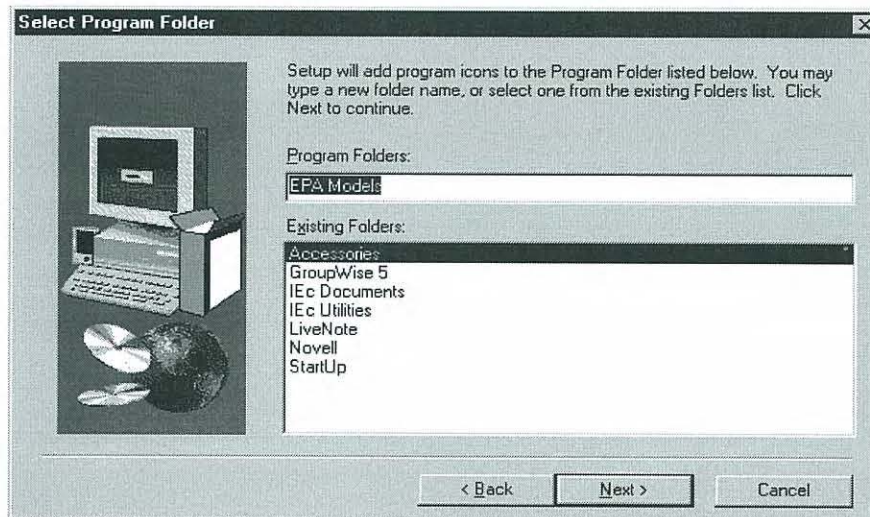


³ This address may have changed by the time you read this manual. To obtain the current address, you can call the helpline at 888-ECON-SPT.

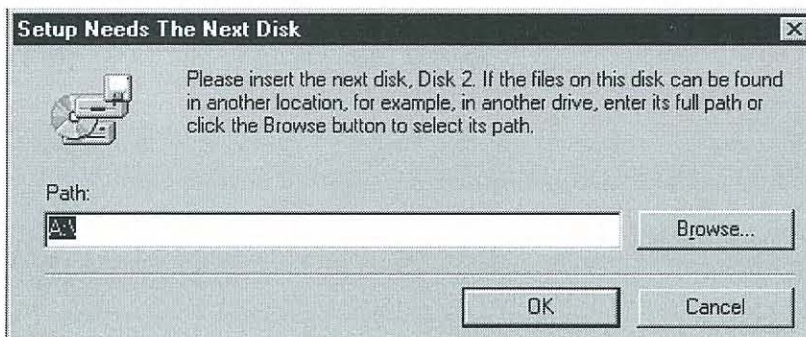
You should close all other programs before installing the model. To do so, click on **[Cancel]**, close the programs and repeat the appropriate steps above. Otherwise click **[Next]** and proceed to the second screen as shown below:



The second screen offers you the opportunity to designate a directory in which to store the model. The default directory is “c:\BENPRJ” (assuming that your local hard drive is c:\). If you wish to save the model to a different directory, press **[Browse]** and choose your desired directory. To proceed with the BEN/PROJECT installation, press **[Next]**. The next setup screen allows you to choose a program folder name as shown below:



The default folder name is EPA Models, which you may alter. To continue installation press [Next]. BEN/PROJECT will partially install and then prompt you for Disk 2, as shown below:



If the files are not on Disk 2 you may type their location or use browse to find them. Press [OK] when the path is correct. If the program is on two disks, simply insert Disk 2 and press [OK]. The setup program will create icons for BEN and PROJECT and finish installing them. When you have completed the installation process, you should reboot your computer prior to using the BEN model or any other software package.

Once BEN has been loaded onto your hard drive, simply double-click the model icon to start the program. If you did not change the default directory and folder, BEN and PROJECT will automatically be listed on the start menu under programs in the “EPA Models” folder.

After installing the model, you may wish to create a subdirectory for storage of all your case files. Alternatively, you may also choose to save your case files in any pre-existing directories corresponding to different cases or projects

C. DATA ENTRY

BEN is a Windows™-based computer program. Like other Windows™-based programs it uses the mouse or the Enter and Tab keys to move from entry to entry or from screen to screen. Hold down the Shift key while pressing Tab to return to previous entries. Each screen has several options and spaces for input.

BEN will accept several entry formats. Numerical values can include but do not require commas. Monetary values may include decimals but will be rounded to the nearest dollar. They may be entered with or without dollar signs. Rates or percentages should be entered as a decimal number without a percent symbol (e.g., enter 0.20 to represent 20 percent). If you type 2.5 for an inflation rate, BEN will read it as an inflation rate of 250 percent.

BEN converts all dates to a “1-Jan-1998” format, but can understand almost any sensible format. If you enter an atypical date format, be sure to check that BEN has interpreted it as you intended. If you do not enter a day, BEN will assume the first day of the month.

Be careful to use only number keys to enter numerical values. A frequent mistake is typing the lowercase letter **L** instead of a number **1**. Another error occurs when the capital letter **O** is typed instead of the number **0** (zero).

BEN will tell you if the format for the entry is incorrect. If this happens, correct the number and enter it again. Some inputs are limited to a range of values. If an entered value falls out of this range, BEN will display an error message with the allowable range of values. Other error messages will appear if you did not enter data in a required field. You may enter variables on the same screen in any order. The only exception to this is that you must have entered all of the inputs for a case before you create a run. Therefore you will receive non-entry error messages only when moving from screen to screen or creating a run.

After typing your entry you might discover that you have typed an incorrect letter or number. Typing errors are easy to correct: simply return to the relevant value and type over the mistake. Like all computer programs, BEN follows the GIGO protocol: “Garbage In, Garbage Out.” Verifying your data inputs is therefore extremely important.

D. CALCULATING AND PRINTING RESULTS

To perform an economic benefit calculation, select the desired run title from the list on the main screen and press [**Calculate**]. You may calculate multiple runs and display the results simultaneously by selecting multiple run titles (i.e., select a run and then click on subsequent desired runs, while simultaneously holding down the Control key). A new screen will display a summary of the results as shown below.

You can may print either a summary of the results or detailed background spreadsheet pages. The “Summary” option will print only the information contained in the summary results screen. The “Detail” option will print, separately for each run, a summary page and spreadsheet pages that include: (1) Illegal Competitive Advantage, which lists possible sources of additional economic benefit (omitted if the user does not check off any such conditions for the case inputs); (2) Discount/Compound Rate Calculation, which provides the details for the cost of capital calculation (omitted if the user overrides BEN’s calculations on the Options screen); (3) Calculations for Specific Cost Estimates, which essentially prints the similarly named screen (omitted if the user overrides BEN’s calculations on the Options screen); and (4) Cash Flow (maximum of four pages), which show the annual cash flow and net present value calculations.

Run Name = Test Run	
Present Values as of Noncompliance Date (NCD),	01-Jan-1993
A) On-Time Capital & One-Time Costs	\$941,041
B) Delay Capital & One-Time Costs	\$614,870
C) Avoided Annually Recurring Costs	\$24,150
D) Initial Economic Benefit (A-B+C)	\$350,321
E) Final Econ. Ben. at Penalty Payment Date,	
	01-Jan-2000
	\$713,872
<i>C-Corporation w/ MA tax rates</i>	
Discount/Compound Rate	10.7%
Discount/Compound Rate Calculated By:	BEN
Compliance Date	01-Jan-1998
<u>Capital Investment:</u>	
Cost Estimate	\$1,000,000
Cost Estimate Date	01-Jan-1993
Cost Index for Inflation	PCI
# of Replacement Cycles; Useful Life	1; 15
Projected Rate for Future Inflation	N/A
<u>One-Time, Nondepreciable Expenditure:</u>	
Cost Estimate	\$100,000
Cost Estimate Date	01-Jan-1993

Print

Printer
 File

BEN also allows you to save a copy of the calculation summary by using the print-to-file option. To do so, click on the **[File]** button in the lower left hand corner before clicking the **[Summary]** button. BEN will ask you to choose a name and directory for the resulting output file. The data is saved in a .htm file and can be viewed using any world wide web browser (e.g. Netscape Navigator™, Microsoft Explorer™) or imported into most word-processing applications. To switch back to printer mode after printing to a file, click on the **[Printer]** button in the lower-left corner.

For more information on interpreting the printouts, consult Appendix A of the *BEN User's Manual*, or call EPA's toll-free enforcement economics support helpline at 888-ECON-SPT (326-6778).

Although printing is done from the output screen, the printer setup is controlled by the pull-down menu on the main screen. The printer setup allows you to shift between landscape and portrait printing, as well as choose more advanced options.

E. EXITING AND SAVING

Exit BEN just like any other standard Windows application. From the main screen, select Exit under the File pull-down menu at the top left corner of your screen, or click on the [x] button at the top right corner of your screen. You can also double-click on the BEN icon at the top left corner of your screen. BEN will ask you if you want to save your work before you exit.

Be sure to save your case(s) before you exit. You save a case by selecting "Save" under the File menu (or give the case a new name by selecting "Save As..."), or the Ctrl+S shortcut. BEN cases are automatically saved with the extension ".ben" and can be accessed using the "Open" command under the File menu or the Ctrl+O shortcut. You can save cases in any folder, and switch between different folders at any time. Runs are automatically saved as part of a case.

To run BEN, you enter certain data, including the entity’s tax status and state; the dates for penalty payment, noncompliance, and compliance; and the compliance cost estimates and estimate dates. BEN provides standard values — which you can modify — for tax, inflation, and discount rates, as well as the capital equipment’s number of replacement cycles and useful life, and the one-time nondepreciable expenditure’s tax deductibility. This chapter explains these variables (in the order in which you enter them in BEN), covering the criteria for developing input values and the basis for the standard values. Each explanation also states how a change in each variable’s value will affect the economic benefit result, as summarized below (holding all other variables constant).

Input Item	Direction of Change	Impact on Economic Benefit
Marginal Tax Rate	increase	decrease
Penalty Payment Date	later	increase
Cost Estimates	increase	increase
Noncompliance Date	later	decrease
Compliance Date	later	increase
Discount/Compound Rate	increase	increase
Number of Replacement Cycles	increase	increase
Useful Life of Capital Equipment	increase	decrease
Projected Rate for Future Inflation	increase	varies
Cost Index for Inflation	PCI to other index	varies
Tax-Deductibility of One-Time, Nondepreciable Expenditure	tax deductible to not tax deductible	increase

A. CASE SCREEN

The case screen shown below is what you see when you first open BEN. This is where you enter the following variables: case name, office/agency, analyst name, entity tax status, state, marginal tax rate, penalty payment date, and run name. It is also where you consider questions of competitive advantage. The right side of the case screen is where you create, edit, calculate and remove runs.

1. Case Name, Office/Agency, Analyst Name

The screenshot displays the BEN software interface. The window title is "BEN" and the menu bar includes "File", "Window", and "Help". The main window is titled "Example.ben". The interface is divided into several sections:

- Case:** Includes fields for "Case Name" (Example Case), "Office/Agency" (Region 1), and "Analyst" (J. Analyst).
- Taxes:** Includes radio buttons for "Entity" (Not-For-Profit, C-Corporation, For-Profit Other than C-Corporation), a "State" dropdown (MA), a "Customize Taxes" button, and a checkbox for "Taxes Have Been Customized".
- Competitive Advantage:** Includes a button.
- Penalty Payment Date:** Field showing "01-Jan-2000".
- Runs:** Includes a "New Run" field, an "Add" button, and a list of "Existing Runs" (Test Run, Test Run 2 - Ed 1 / 1/2000). Buttons for "Enter/Edit", "Calculate", "Copy", and "Remove" are on the right.

Case name, office/agency, and analyst name are the first three inputs in BEN. They are for reference purposes only and do not affect the calculation. Each of them will appear along with the current date on the bottom of every page of the results.

a. Case Name

Case name is the first input in BEN. This name can be any length and can contain letters, spaces, punctuation and numbers (although you may not leave it blank). It will appear along with the current date, analyst name, and EPA region on each page of the results. Since its sole purpose is documentation, this label can contain anything you choose. It can reflect the violator's name or a characteristic of the specific case (e.g., "Payment on July 15, 1999"). Each case can contain several runs, so you will not need to alter the case name to save individual calculations.

b. Office/Agency

Like case name, office/agency is for reference purposes only (although you may not leave it blank). It will appear along with the current date, case name, and analyst name on each page of the results. A pull down menu to the right of the cell lists all ten EPA regions, EPA headquarters, and the option of "other." You may also type in a different entry.

c. Analyst Name

Like case name and office/agency, analyst name is for reference purposes only (although you may not leave it blank). This name can be of any length and can contain letters, spaces, punctuation and numbers. It will appear along with the current date, case name, and EPA region on each page of the results. It can be anything you choose, but it is most appropriate simply to enter your own name.

2. Entity Type, State, Customized Tax Rate

BEN needs to know the violator's tax rate to calculate economic benefits, as compliance costs are usually tax-deductible. Because tax-deductible expenses and depreciation associated with capital investments reduce taxable income they result in tax savings. The higher the tax rate, the higher the tax savings, and therefore the lower the economic benefit of noncompliance. BEN uses the marginal tax rate to account for the tax effects of compliance costs. Changing the violator's state or tax status changes the violator's marginal tax rate and thus alters economic benefit.

a. Entity Type

BEN asks you to designate the tax filing status of the entity. The three options are: Not-For-Profit, C-Corporation, or For-Profit Other than C-Corporation. Choosing the correct tax status is critical, because it determines BEN's application of the tax rate and the discount/compound rate. BEN will default to C-Corporation status.

A C-Corporation files a federal tax Form 1120 or Form 1120-A. These companies are taxed at corporate income tax rates. Virtually all publicly traded companies are C-Corporations, but small privately held firms can also be C-Corporations.

For-profit entities other than C-corporations may be S-corporations, partnerships, or sole proprietorships (e.g., a corner grocery store). These entities file federal tax returns other than 1120 or 1120-A (e.g., an S- corporation files a Form 1120-S and a Schedule K for each shareholder). The income and expenses of these organizations are divided among the shareholders and reported on their individual income tax returns. Income is therefore taxed at the individual income tax rate.

Not-for-profit entities, such as municipalities, public authorities, and charitable organizations, generally have a tax-exempt status. When you indicate that the violator is a not-for-profit entity, BEN sets the marginal income tax rate to zero. (Although rare, certain not-for-profit companies are subject to taxation. You should verify the status of the not-for-profit in question and adjust the tax rates accordingly.)

b. State

This is the state in which the entity conducts the majority of its business, which is not necessarily the state in which it is incorporated. Selecting the correct state is important because BEN uses state-specific tax rates in its calculations. The pull-down menu lists all fifty states plus “AVG” and “BEN.” “AVG” is an average of all state tax rates (appropriate if the noncompliant facilities span several states). “BEN” is similar to “AVG”, but instead of adjusting the state average each year, it uses one state average for the period 1987-1992 and another for 1993 and beyond. This option is appropriate only for replicating prior calculations from the DOS version of BEN, which used these rates as its standard value.

c. Customized Tax Rate

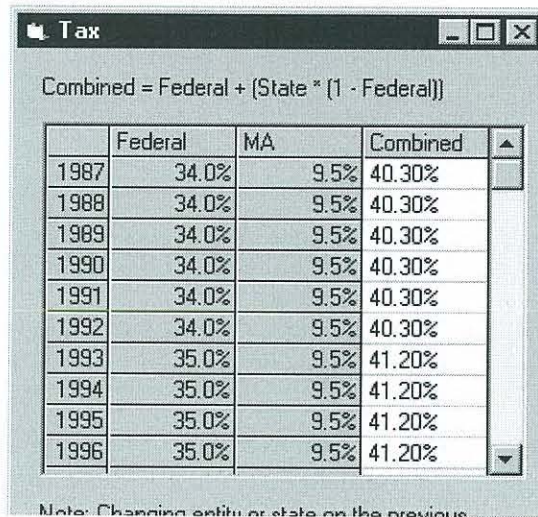
After you have entered the tax status and state of the violator, BEN will automatically calculate the combined marginal income tax rate. The marginal tax rate is the fraction of the last dollar of taxable income that a defendant would pay to federal and state governments. BEN uses the marginal tax rate, not the average tax rate (i.e., total tax divided by total taxable income), because the marginal tax rate is the rate that applies to incremental changes in the violator’s tax-deductible expenses.

State tax rates must be adjusted to reflect the fact that you can deduct state taxes from federal taxable income. The adjustment is made by multiplying the marginal state tax rate by a factor equal to one minus the marginal federal tax rate, as shown in the following formula:

$$\text{Combined tax rate} = \text{Federal rate} + [\text{State rate} \times (1 - \text{Federal rate})]$$

State income taxes do not include sales tax, inventory tax, charter tax, or taxes on property. One-time tax payments, such as taxes on the purchase of equipment, should be included in the capital investment or in the one-time nondepreciable expenditure. If the tax recurs regularly, then it should be included in the annually recurring cost. For example, sales tax would be included in the capital cost while property tax would be included in the annual cost.

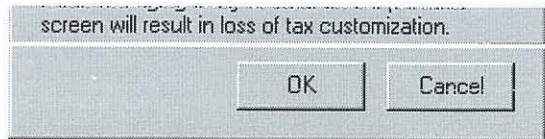
You may have information that supports the use of tax rates other than those supplied by the BEN model (e.g., the entity was not subject to the highest marginal rate). In these situations you can modify the annual rates individually by pressing [**Customize Taxes**]. The tax customization window shown below will appear and you can simply type in your customized values.



Combined = Federal + (State * (1 - Federal))

	Federal	MA	Combined	
1987	34.0%	9.5%	40.30%	
1988	34.0%	9.5%	40.30%	
1989	34.0%	9.5%	40.30%	
1990	34.0%	9.5%	40.30%	
1991	34.0%	9.5%	40.30%	
1992	34.0%	9.5%	40.30%	
1993	35.0%	9.5%	41.20%	
1994	35.0%	9.5%	41.20%	
1995	35.0%	9.5%	41.20%	
1996	35.0%	9.5%	41.20%	

Note: Changing entity or state on the previous

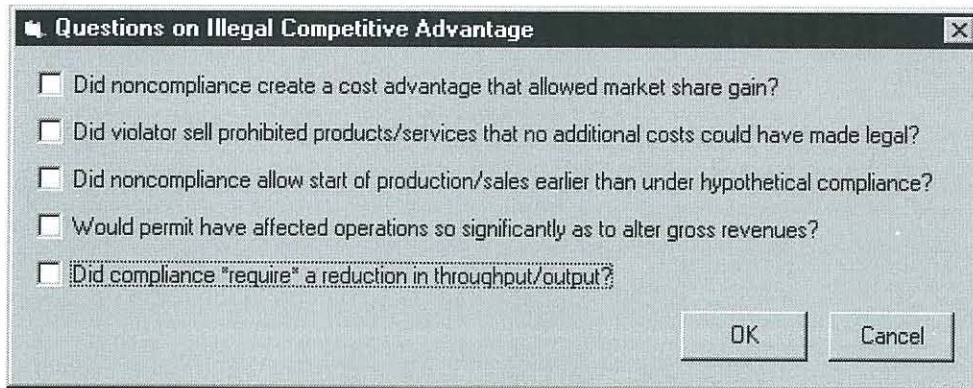


The "Tax Rates Have Been Customized" box on the case screen will be checked when modifications have been made to the tax rates. Similarly, this information will appear in the BEN run results and print-out. Note that once tax rates are modified, re-designation of the state or entity tax status will result in a loss of the customized information.

3. Competitive Advantage

BEN — or any computer model — is incapable of calculating economic benefit from illegal competitive advantage, leading to a possible underestimate of economic benefit in certain cases. Therefore BEN provides a [**Competitive Advantage**] button and asks questions for case attributes indicative of illegal competitive advantage, providing suggestions for further research and analysis.

You must read the competitive advantage screen and press [OK] before BEN will allow you to create a run.



Below are the responses that appear in BEN's results if you check a question box.

1. *Did noncompliance create a cost advantage that allowed market share gain?*

Since noncompliance created a cost advantage that allowed market share gain, detailed examination is necessary: first of supposed cost advantage and causation, and then of actual financial impact.

2. *Did violator sell prohibited products/services that no additional costs could have made legal?*

Since violator sold prohibited products/services that no additional costs could have made legal, determine after-tax profit from illegal sales.

3. *Did noncompliance allow start of production/sales earlier than under hypothetical compliance?*

Since noncompliance allowed start of production/sales earlier than under hypothetical compliance, examine net after-tax cash flows realized from earlier-than-permissible production/sales.

4. *Would permit have affected operations so significantly as to alter gross revenues?*

Since permit would have affected operations so significantly as to alter gross revenues, examine net after-tax cash flow impact from modifications to operations.

5. *Did compliance *require* a reduction in throughput/output?*

Since compliance *required* a reduction in throughput/output, determine after-tax profit from incremental production.

If you answer affirmatively to any of these questions, further research and analysis is necessary to determine the full extent of the violator's economic benefit. You might wish to consult U.S. EPA's guidance on illegal competitive advantage, or contact EPA's enforcement economics support helpline, at 888-ECONSPT (326-6778).

4. Penalty Payment Date

The penalty payment date is the date you expect the violator to pay the civil penalty. Dates can be written out or entered in month/day/year format. For example, January 4, 1998 can be written as January 4, 1998, Jan 4 1998, or 1/4/1998. Four-digit years are preferable, although BEN will accept some two-digit formats. If using numerical abbreviations, be sure to enter the month first, e.g., BEN will interpret 10/2/1998 as October 2, 1998, not February 10, 1998.

BEN automatically calculates the final economic benefit as of the penalty payment date and assumes that the violator earns a return on the benefit until that date. Therefore, the benefit figure increases for later penalty payment dates, holding all other variables constant.

A considerable time lag often occurs between when the violator signs the consent decree and when it actually pays the penalty. If the violator is willing to transfer the entire penalty figure to an interest-bearing escrow account on a date before entry of the consent decree, this escrow date may be used as the penalty payment date. Upon entry of the consent decree, the escrowed penalty plus any interest should accrue to the enforcement agency.

You should be certain that the violator knows: (1) the penalty payment date used in your economic benefit calculation; and, (2) that if the penalty payment date is actually later than you have assumed, the economic benefit will be higher. On the other hand, if the violator settles the case and pays its penalty prior to the date you used in your calculation, or if it agrees to escrow the economic benefit amount, the benefit component of the penalty will be lower. By conveying this information early in a negotiation with a violator, you will give the violator added incentive to settle promptly. In addition, this approach will allow you to avoid giving the violator any "unpleasant surprises" should you need to increase the benefit component as a result of a delay in the settlement.

5. Creating/Adding, Copying, and Removing Runs

You must create a run before you can enter compliance cost information. To add a new run, enter the run name under "New Run:" and press [Add]. BEN will save the new run and list it under "Existing Runs." Run names can be any length and include any letter, punctuation or number. Each case may contain multiple runs.

To copy an existing run select the run you wish to copy from the list of existing runs and press **[Copy]**. A window will appear asking you to enter a name for the new run. No two runs can have the same name. Enter the new name and press **[OK]** to save the new run or **[Cancel]** to delete it. The copy will contain all of the information from the original. Copies are particularly useful when making only minor changes in cost information from run to run, because they can carry over consistent data.

To remove a run select it from the existing run window and press **[Remove]**. A window will appear asking you if you are sure. Press **[Yes]** and the run is deleted. Remember that BEN does not have a “trash bin” to hold deleted runs, so you will have no way to retrieve a run once you have removed it.

B. RUN INPUT SCREEN

To access the run input screen, select a run and press **[Enter/Edit]**, or simply double click on the run name. Here you enter cost estimates for three possible compliance components: capital investments, one-time nondepreciable expenditures and annually recurring costs. Each cost component requires a cost estimate and an estimate date. At the bottom of the run screen you must enter the noncompliance and compliance dates.

Compliance Components		
	Cost Estimate	Estimate Date
Capital Investment:	1000000	01-Jan-1993
One-Time, Nondepreciable Expenditure:	\$100,000	01-Jan-1993
Annually Recurring:	\$10,000	01-Jan-1993

Dates	
Noncompliance:	01-Jan-1993
Compliance:	01-Jan-1998

OK Options Cancel

1. Compliance Cost Components

This is where you enter the costs of the equipment/labor/activities necessary to achieve compliance. Engineers and technical staff in your enforcement program are usually aware of what reasonable costs might be for pollution control technologies and remedial activities, and might also know of standard cost information that exists in publications. Another potential source of information is the violator, who might willingly give you the required data. Otherwise, you can take a number of legal approaches to obtain the data from the violator. The EPA usually has authority to request the necessary information. With a legal issue like this one, the appropriate attorney(s) should also be consulted. In cases where cost data is available, but the required compliance measures are still unclear, two general guidelines will assist you:

(1) The best evidence of what the violator should have done to prevent the violations is what it eventually did (or will do) to achieve compliance. This rule is instructive in those cases where the violator may appear to be installing a more expensive pollution control system than EPA staff believe is necessary to achieve compliance. In such situations, the proper cost inputs in the BEN model are usually still based on the actual (more expensive) system being installed. This is because the EPA should not second guess the business decisions of a violator. A violator often will have sound business reasons to install a more expensive compliance system (e.g., it may be more reliable, easier to maintain, or have a longer useful life).

(2) Costs not truly associated with pollution control efforts to remedy the violations alleged in the complaint should be excluded from BEN inputs, but the violator must present convincing evidence that the costs were not associated with the operation of the pollution control system. For example, if the violator is adding additional capacity to handle a waste stream from a new production line, the incremental costs associated with treating the new waste stream should not be included in the BEN run (based on the assumption that the additional capacity for treatment of wastes from new production was not needed to achieve compliance under previous levels of production). Similarly, if the violator is adding capacity to accommodate normal anticipated business growth, and on-time compliance would not have entailed such additional capacity, then you should exclude the incremental costs of the additional capacity.

You may enter compliance costs with or without commas or dollar signs. BEN will accept decimals but will round the amount to the nearest whole dollar. Enter a zero for any component category where expenses would not be incurred. All else being equal, larger compliance costs will result in a higher economic benefit of noncompliance.

a. Capital Investment

The capital investment cost estimate should include all depreciable investment outlays necessary to achieve compliance. Generally these are expenditures the violator delayed making (although they could sometimes be avoided altogether). Enter a zero if no capital investment was

required for compliance. Holding all other inputs constant, the economic benefit from delay will be greater for larger capital investment outlays.

Depreciable capital investments are made for things that wear out such as buildings, equipment or other long-lived assets. Note that land is not a depreciable capital investment; land costs should instead be input as a one-time non-depreciable expenditure. Typical environmental capital investments include groundwater monitoring wells, stack scrubbers, and wastewater treatment systems. In estimating capital cost, keep in mind this includes all costs associated with designing, installing, shipping, and purchasing the necessary equipment (including sales tax) and associated facilities.

If the capital investment is avoided (i.e., the violator is not just delaying making the investment, but will never make the investment), after entering all the required information on the run inputs screen, on the options screen uncheck the “Delayed, Not Avoided” box and set the replacement cycles to 0. (If a replacement cycle has also been avoided, then retain the default cycle of 1.)

If you have capital investment costs with significantly different cost estimate dates, you should perform separate runs for each, which you can add together to produce a total economic benefit result.

b. One-Time, Nondepreciable Expenditure

This category includes compliance expenditures that need to be made only once and are non-depreciable (i.e., do not wear out). Enter a zero if no one-time nondepreciable expenditure was required for compliance. Holding all other inputs constant, the economic benefit from delay will be greater for larger one-time nondepreciable expenditures.

Such an expenditure could be purchasing land, setting up a record-keeping system, removing illegal discharges of dredged and fill material, disposing of soil from a hazardous-waste site, or initial training of employees. However, if training or record keeping must occur over time and regularly, these costs should be entered as annually recurring costs. If the one-time nondepreciable expenditure involved is avoided (i.e., the violator is not just delaying making the expenditure, but will never make the expenditure), on the options screen uncheck the “Delayed, Not Avoided” box.

Most one-time nondepreciable expenditures are tax-deductible; with the primary exception being purchases of land. Land is an asset and, therefore, cannot be deducted as an expense from taxable income. BEN assumes that the expenditure is tax-deductible unless otherwise specified. To change this assumption uncheck the “Tax Deductible” box on the options screen.

c. Annually Recurring Costs

Annually recurring costs are costs associated with operating and maintaining pollution control equipment. Enter a zero if no (additional) annual costs were required to operate the necessary pollution control equipment. Holding all other inputs constant, the economic benefit from delay will be greater for larger annually recurring costs.

This cost estimate should reflect the average annual incremental cost of operating and/or maintaining the required environmental control measures. These expenditures should include any changes in the cost of labor, power, water, raw materials and supplies, recurring training of employees, and any change in annual property taxes associated with operating the new or improved pollution control equipment. Note that annually recurring costs may be negative if compliance increases efficiency. Include any lease payments for equipment, but not expenses such as annualized capital recovery, interest payments, or depreciation.

Any operating and maintenance (O&M) offsetting credits should also be considered in determining the incremental annual costs. Such credits might represent actual O&M cost savings: heat recovery, product or byproduct recovery, and so forth. To be included, such savings must be proven by the violator, not just asserted. For example, the installation of new pollution control equipment may reduce certain costs (such as sludge disposal) associated with operations during the noncompliance period. If the resulting incremental O&M cost is negative, the net cost savings may be used in determining annual costs. Credit is given only for annually recurring cost savings that are both documented and directly related to compliance.

Annual costs must be equal for each year of the violation, differing only by inflation, to enter them into BEN. If they vary only slightly, you can enter an average estimate of the different yearly figures. If they vary significantly, then you can create separate runs corresponding to the different years of the violation. Each run's noncompliance and compliance dates should reflect the beginning and ending dates for the year of the specific annual cost.

If the annual costs are delayed, and not avoided, then enter them as one-time nondepreciable expenditures. You can either enter the entire sum of the annual costs that have been delayed over the entire noncompliance period, or you can create a separate run for each year of delayed costs. Either way, the noncompliance date should be the midpoint of when the annual costs should have been incurred (i.e., the midpoint of the entire noncompliance period, or the middle of the year), and the compliance date should be the midpoint of when the costs were or will be incurred.

2. Cost Estimate Dates

Each cost estimate needs a date, reflecting the date on which the estimate is premised. Dates can be written out or entered in month/day/year format. For example, January 4, 1998 can be written as January 4, 1998, Jan 4 1998, 1-4-1998, or 1/4/1998. Four-digit years are preferable, although

BEN will accept some two-digit formats. If using numerical abbreviations, be sure to enter the month first, e.g., BEN will interpret 10/2/1998 as October 2, 1998, not February 10, 1998. You must enter dates to the day. If you do not have date information to the day, use the day that falls in the middle of the time frame you have. For example, if all you know is that the estimate was made in May of 1998, use May 15, 1998 as the estimate date. If all you know is that the estimate was made in 1998, use July 1, 1998 as the estimate date. If you have multiple costs for the same component with different dollar-years, enter them as separate runs, and sum the results.

3. Noncompliance and Compliance Dates

For all dates you can use any format, but be sure to enter the year, month, and day. (If you do not enter a day, BEN will assume the first day of the month.) Also, BEN will not accept any dates before July 1, 1987.

The noncompliance date is generally when the first violation of the environmental requirement occurred. BEN uses this as the proxy for when the violator should have actually incurred the expenditures necessary for compliance. Since compliance expenditures must often occur far in advance of actual legal compliance, it is highly conservative to use the date by when the violator should have completed installation of the necessary pollution control equipment and had such equipment fully operational. The benefit from delayed and/or avoided expenditures generally increases with the length of the delay period. An earlier noncompliance date (holding the compliance date constant) will, in virtually all cases, increase the benefit figure. Hence, if you were to use the actual date when the compliance expenditures would have been incurred — if this information were available — the economic benefit would be substantially higher than how EPA typically calculates it.

The compliance date is when the violator came into compliance with environmental requirements or the date when you expect the violator to achieve compliance. BEN once again uses this as the proxy for when the violator actually did — or will — incur the expenditures necessary for compliance. The date when the equipment was initially installed is not necessarily sufficient: the violator needs to be in compliance (for consistency with the noncompliance date), and have already incurred all of the capital and one-time costs and started to incur the annual costs. (Often a significant amount of time is required to “break-in” the equipment and adjust it; thus the compliance date is when compliance is actually achieved.)

Remember though that BEN is ultimately concerned with financial — not legal — dates: your object should be to “follow the money.” (In an extreme example, if a violator were to install the required capital equipment — yet for some reason not operate it — then for the purposes of BEN’s calculations of the capital investment economic benefit the violator is in compliance.) Using the legal dates of noncompliance and compliance can be a useful proxy, and will keep the noncompliance time period the correct length, but it will generally underestimate the true economic benefit (since the noncompliance period is being artificially shifted closer to the penalty payment date).

Note that in economic benefit analyses, the compliance date must occur after the noncompliance date. A later compliance date (holding the noncompliance date constant) will, in virtually all cases, increase the economic benefit figure. If you are running BEN to calculate the after-tax net present value of an “early compliance” supplemental environmental project, then enter the date when the violator will comply early as the noncompliance date, and the date when the violator is required to comply as the compliance date.

The dates are a major consideration in the BEN analysis. As the interval of non-compliance increases, the economic benefit generally increases. For each month that the violator delays compliance, it delays capital and one-time costs and avoids operation and maintenance expenses. In practice, the period of violation is sometimes not clear. Proving the entire period of violation might encounter evidentiary problems. It might be helpful to perform several different BEN runs to show the impact of different violation periods on economic benefit.

Although a statute of limitations may apply in your case, it should generally affect only the maximum penalty you can assess (i.e., the statutory cap). Since you are only trying to calculate the amount the violator gained by violating the law, you may go beyond any statute of limitations, as long as you do not exceed the statutory cap. Should your case go to trial or hearing, you should consult your legal staff before going forward with a benefit amount based on the earlier violations.

Another point to keep in mind is that as of the date the BEN analysis is performed, the violator might not yet be in compliance. Therefore, you must make an assumption regarding the date of eventual compliance. In discussions with the violator about the BEN calculation, you should be explicit about your compliance date assumption. You should then make clear to the violator that further delays in compliance will yield a higher economic benefit, and thus a higher penalty. Conversely, earlier compliance will yield a lower penalty. By conveying this information up front, you will give the violator added incentive to comply early, and will also avoid having to give the violator any “unpleasant surprises” should you have to increase the benefit component of the penalty.

C. OPTIONS

The standard values in BEN are updated annually to reflect changes in interest rates, tax law, and so forth. Although these values are updated, the assumptions upon which they are based remain the same. If the case you are analyzing is significantly different from that represented by the standard values, you may wish to customize some of the optional inputs. In particularly complicated cases, you might also want to consult the EPA helpline (888-ECON-SPT).

The options screen allows you to modify the discount/compound rate, cost indices for inflation, number of replacement cycles, whether a cost is delayed or avoided, the useful life of capital equipment, future inflation rate, and the tax deductibility of one-time nondepreciable expenditures.

You should customize these variables only if you have reliable information to substantiate the change.

Test Run: Optional Inputs

Discount/Compound Rate: 10.7%

Capital Investment

Cost Index for Inflation: PCI

Number of Replacement Cycles: 1

Useful Life of Capital Equipment: 15

Projected Rate for Future Inflation: 1.7%

Delayed, Not Avoided

One-Time, Nondepreciable Expenditure

Cost Index for Inflation: PCI

Tax Deductible

Delayed, Not Avoided

Annual Costs

Cost Index for Inflation: PCI

OK Specific Cost Estimates Cancel

1. Discount /

Compound Rate

To compare the on-time and delayed compliance costs from different dates in a common measure, BEN adjusts both streams of costs (i.e., “cash flows”) for inflation as of the date of initial noncompliance. After determining the initial economic benefit as of the noncompliance date (i.e., the difference between the on-time-case present value and the delay-case present value), BEN compounds this amount forward to the penalty payment date. To perform these present value calculations, BEN must employ a discount/compound rate that reflects the violator’s “time value of money.”

For a for-profit entity’s discount/compound rate, BEN uses the weighted-average cost of capital (WACC) for a typical company, reflecting the cost of debt and equity capital weighted by the value of each financing source. A company must on average earn a rate of return necessary to repay

its debt holders (e.g., banks, bondholders) and satisfy its equity owners (e.g., partners, stock holders). While companies often earn rates in excess of their WACC, companies that do not on average earn at least their WACC will not survive (i.e., their lenders will not receive their principal and/or interest payments, and their owners will be dissatisfied with their returns). The WACC represents the return a company can earn on monies not invested in pollution control, or, viewed alternatively, represents the avoided costs of financing pollution control investments. Thus, a company should make its business decisions by discounting cash flows at its WACC, and BEN follows the internal analysis a company will normally perform.

For a not-for-profit discount/compound rate, BEN uses a typical municipality's cost of debt, based on interest rates for general obligation bonds.

You can view BEN's discount/compound rate calculation by selecting the detail printouts after you calculate a run. BEN calculates the rate in each year, then uses the average of the annual rate over the period from the year of initial noncompliance through the year of penalty payment. Each year EPA appends the BEN model so that it contains another year of data for the annual rates.

Some violators will argue for rates tailored to their industry, company, or specific division, or, for a not-for-profit entity, actual bond issues or debt ratings. In general, you should involve a financial analyst or contact the U.S. EPA enforcement economics toll-free helpline at 888- ECONSPT (326-6778) if the violator raises an issue about the cost of capital. Also, you should inform the violator that a case-specific cost of capital could result in a higher discount/compound rate, which will increase the economic benefit result.

If you customize the discount rate, be sure to enter it as a decimal. BEN will automatically convert it to a percentage.

Discount/Compound Rate Calculation

Notes:

- (1) Corporate bond rates averaged across all industries; Federal Reserve Bulletin, Table 1.35.
- (2) Combined state/federal marginal tax rates: $\text{federal} + (\text{state} * (1 - \text{federal}))$; Federation of Tax Administrators.
- (3) Calculated as: $(1) * (100\% - (2))$.
- (4) Average corporate debt weight; Standard & Poor's Analysts Handbook, S&P Industrials Sample Balance Sheet.
- (5) Federal Reserve Bulletin Table 1.35. [Used as a proxy for the risk-free rate in the Capital Asset Pricing Model (CAPM)].
- (6) Beta measures risk relative to overall stock market with a value of 1.00 therefore assuming risk is same as market.
- (7) Differences of average returns between stock market and 5-yr T-notes, 1926 - prior yr; Ibbotson Associates Handbook.
- (8) Calculated as $(6) * (7)$. [Also equal to (7), since (6) is equal to 1.00 for a company of average risk.]
- (9) Calculated as $(5) + (8)$. [Reflects risk-free rate of return plus the company risk premium.]
- (10) Calculated as $100\% - (4)$. [Reflects: total financing - debt = equity financing.]
- (11) Calculated as $(3) * (4) + (9) * (10)$. [Reflects: (debt cost x debt weight) + (equity cost x equity rate).]

YEAR	(1) Cost of Debt	(2) Tax Rate	(3) After-Tax Debt Cost	(4) Debt Weight	(5) 5-Year Treasury Notes	average from: 1993			to: 2000			(11) Final Rate: 10.7%
						(6) Beta	(7) Intermed. Horizon Risk Prem	(8) Company Risk Premium	(9) Equity Cost	(10) Equity Weight		
1987	9.9%	40.3%	5.9%	43.0%	7.94%	1.00	7.7%	7.7%	15.6%	57.0%		
1988	10.2%	40.3%	6.1%	52.0%	8.47%	1.00	7.3%	7.3%	15.8%	48.0%		
1989	9.7%	40.3%	5.8%	49.0%	8.50%	1.00	7.4%	7.4%	15.9%	51.0%		
1990	9.8%	40.3%	5.9%	50.0%	8.37%	1.00	7.8%	7.8%	16.2%	50.0%		
1991	9.2%	40.3%	5.5%	49.0%	7.37%	1.00	7.5%	7.5%	14.9%	51.0%		
1992	8.6%	40.3%	5.1%	47.0%	6.19%	1.00	7.7%	7.7%	13.9%	53.0%		
1993	7.5%	41.2%	4.4%	47.0%	5.14%	1.00	7.6%	7.6%	12.7%	53.0%	8.8%	
1994	8.3%	41.2%	4.9%	44.0%	6.69%	1.00	7.6%	7.6%	14.3%	56.0%	10.2%	
1995	7.8%	41.2%	4.6%	42.0%	6.38%	1.00	7.4%	7.4%	13.8%	58.0%	9.9%	
1996	7.7%	41.2%	4.5%	37.0%	6.18%	1.00	7.8%	7.8%	14.0%	63.0%	10.5%	
1997	7.5%	41.2%	4.4%	27.0%	6.22%	1.00	7.9%	7.9%	14.1%	73.0%	11.5%	
1998	6.9%	41.2%	4.1%	25.0%	5.15%	1.00	8.2%	8.2%	13.4%	75.0%	11.1%	
1999	7.5%	41.2%	4.4%	25.0%	5.55%	1.00	8.4%	8.4%	14.0%	75.0%	11.6%	
2000	8.0%	41.2%	4.7%	25.0%	6.15%	1.00	8.5%	8.5%	14.7%	75.0%	12.2%	

2. Inflation Indices and Projected Inflation Rate

For actual historical inflation, BEN adjusts each cash flow from the date of the cost estimate by referencing a look-up table of cost index values.⁴ The default cost index is the Plant Cost Index, from the magazine *Chemical Engineering*. This particular index may not be appropriate for every case. Thus BEN offers a pull-down menu for each compliance component listing other available cost indices. The inflation rate for each compliance cost category may be modified individually because the different cost categories may be affected by different inflationary trends. The table on the next page summarizes the optional indices. (EPA modifies the BEN model each year to include new data from each index.) For projected future inflation, BEN extrapolates each cost index forward in time at a separate forecasted rate.⁵

In addition to the option of selecting an alternative to the PCI, BEN offers two other ways to modify its inflation adjustments.

First, BEN uses a separate projected future inflation rate for any additional recurring capital replacement cycles after the first one. You can override the standard value, which is based on the PCI projected rate for future inflation. If you modify the inflation rate, be sure to enter it as a decimal. BEN will automatically convert it to a percentage.

Second, on the "Specific Cost Estimates" screen, you can override BEN's inflation adjustments for the capital investment and one-time nondepreciable expenditure, and instead enter separate estimates for these compliance costs as of the noncompliance date, compliance date, and the initial recurring cycle start dates. This customized data entry can represent another alternative cost index, case-specific inflation assumptions, or entirely different actions for on-time and delayed compliance.

⁴ Unlike the earlier DOS version, BEN no longer applies an explicit inflation rate, although an annualized rate could be imputed from the model's data. For example, suppose a \$200 cost estimate from 1991 must be adjusted for inflation to the same day in 1992. The 1991 cost index value is 100, whereas the 1992 index value is 103. The calculation the model performs is $\$200 * 103 / 100 = \206 (i.e., multiplying the original cost estimate by the ratio of the cost index values from the date on which the cost is actually incurred, and the date on which the estimate is made). The index change from 1991 to 1992 does represent an annual inflation rate of three percent (i.e., $103 / 100 = 1.03 - 1 = 0.03$), but the model does not directly apply this rate. A calculation that uses the ratio of the index values is both more precise and more simple than one that calculates multiple annual inflation rates over different periods for historical costs.

⁵ This is based upon a consensus forecast for the Consumer Price Index (CPI) and each individual index's historical relationship to the CPI. The rationale for the calibration of the other indices to the CPI is that the CPI has widely available forecasts for projected inflation, but the others do not.

INFLATION INDICES			
Abbreviation and Full Name		Description	Typical Applications
BCI	Building Cost Index	building costs; based on 1.128 tons Portland cement, 1,088 bd. ft. 2x4 lumber, 68.38 hrs. skilled labor	general construction costs, especially structures
BEN	current BEN model's constant inflation rate	average of PCI's last 10 years; i.e., a <u>constant</u> 1.8% increase each year	replication of results from current BEN model version
CCI	Construction Cost Index	construction costs; same as BCI, except 200 hrs. common labor	general construction projects, especially where labor costs are a high proportion of total costs
CPI	Consumer Price Index	representative consumer goods	compliance somehow involves consumer goods
ECIM	Employment Cost Index: Manufacturing	employment costs for the manufacturing industry	one-time nondepreciable expenditures or annual costs that comprise mainly labor
ECIW	Employment Cost Index: White Collar	employment costs for white collar labor	same as ECIM, except professional labor (e.g., permits)
PCI	Plant Cost Index	plant equipment costs	standard value

3. Capital Investment Replacement Cycles and Useful Life

You can specify the number of replacement cycles for the capital equipment, and the useful life of the equipment (i.e., the years between replacement cycles). A violator who delays installing pollution control equipment for, say, five years, benefits not only by delaying the initial expenditure five years, but also by postponing the second and potentially subsequent replacement cycles by the same five years.

The BEN model defaults to one replacement cycle, although you can specify as many as five. Because the present value of future costs decreases rapidly the further they occur from the present, additional replacement cycles after the first cycle typically have almost no significant impact upon the economic benefit result.

Not all capital investments need to be replaced at the end of their useful lives. For example, groundwater monitoring wells or other equipment used to close a RCRA site may not need to be replaced. By contrast, water and air pollution control equipment are typically replaced since this equipment is generally needed to support compliance for the foreseeable future. Most capital

investments will be replaced. In identifying equipment as a one-time purchase, you should be convinced that the equipment will not require future replacement. If this is indeed the case, set the number of replacement cycles to zero.

The useful life determines the number of years between replacement cycles. Equipment with a long useful life is replaced less frequently than equipment with a short useful life. Assuming the same investment cost per replacement cycle, the total present value of the costs of replacement for the longer-lived equipment would be lower (since each subsequent investment occurs later). Therefore, a longer useful life reduces the benefit of delaying compliance — holding all other inputs constant — although this impact might be offset somewhat if the shorter useful life triggers a more rapid depreciation schedule.

If your capital investment reflects different pieces of equipment with significantly different replacement cycles and/or useful lives, you need to create separate BEN runs for the differing equipment. You can add together the results from the two calculations to determine the total economic benefit.

4. Avoided vs. Delayed

BEN's default assumption is that both the capital investment and the one-time nondepreciable expenditure are delayed, not avoided. If the violator will instead never incur such compliance costs, then uncheck the "Avoided, Not Delayed" delayed boxes. Also, for an avoided capital investment, you should change the replacement cycles to 0, unless the violator has avoided not only the initial installation but also its replacement.

5. Tax Deductibility of One-Time Nondepreciable Expenditure

Most one-time nondepreciable expenditures are tax-deductible; with the primary exception being purchases of land. Land is an asset and, therefore, cannot be deducted as an expense from taxable income. BEN assumes that the expenditure is tax-deductible unless you uncheck the box.

D. SPECIFIC COST ESTIMATES

The specific cost estimate screen allows you to view BEN's inflation adjustments, which calculate specific cost estimates for certain dates, extrapolating from the original single cost estimate (which you enter on the earlier screen for compliance components data). This screen also allows you to override BEN's calculations for the specific cost estimates. You reach the specific cost estimates screen by pressing [**Specific Cost Estimates**] at the bottom of the options screen.

All data except for the specific cost estimates are "grayed out", since BEN allows to you override only the final estimates, not the intermediate calculations. Changing your inputs on prior screens, however, will have an impact on the "grayed-out" data, unless you click [**OK**] on this screen, which will lock in your inputs on prior screens. (BEN takes this action because otherwise it would not know whether you intended subsequent changes to prior screens to affect the customized data you have entered on this screen.) Clicking [**OK**] on this screen will also visually erase all of the other data when you return to this screen in the future. (BEN takes this action because it does not know how much of the other data you incorporated into your customized specific cost estimates.)

BEN displays four separate columns of data, corresponding to the start dates of the on-time compliance scenario (i.e., the noncompliance date), the delay compliance scenario (i.e., the compliance date), the on-time replacement cycle (i.e., the noncompliance date plus the useful life of capital equipment), and the delay replacement cycle (i.e., the compliance date plus the useful life). The first row simply provides the date for each scenario, as calculated above. The next rows are divided into two groupings: the first for capital investments, and the second for one-time nondepreciable expenditures.

Each grouping starts with a row for the single cost estimate you originally entered on the basic run input screen. The second row then displays the value of the selected cost index (the Plant Cost Index is the default) as of the cost estimate date, and the third row displays the value for the same cost index as the specific cost estimate date. The final row (as the operator signs between the rows indicate) is equal to the first row divided by the second row, multiplied by the third row.

	Compliance Start		Replacement Cycle Start	
	On-Time	Delay	On-Time	Delay
	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
Capital Investment				
Original Cost Estimate:	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
	÷	÷	÷	÷
Cost Index Value as of (A):	357.200	357.200	357.200	357.200
	×	×	×	×
Cost Index Value as of (B):	357.200	388.000	446.936	486.239
	=	=	=	=
Specific Cost Estimate:	1000000	\$1,086,226	\$1,251,221	\$1,361,252
One-Time, Nondepreciable Expenditure				
Original Cost Estimate:	\$100,000	\$100,000		
	÷	÷		
Cost Index Value as of (A):	357.200	357.200		
	×	×		
Cost Index Value as of (B):	357.200	388.000		
	=	=		
Specific Cost Estimate:	\$100,000	\$108,623		

(A) -- Original Cost Estimate Date
(B) -- Specific Cost Estimate Date

OK Cancel

If you click [OK] on the specific cost estimate screen, exit it and then later return, all of the intermediate calculations will be blank, and only the final specific cost estimates will appear:

	Compliance Start		Replacement Cycle Start	
	On-Time	Delay	On-Time	Delay
	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
Capital Investment				
Original Cost Estimate:				
	÷	÷	÷	÷
Cost Index Value as of (A):				
	×	×	×	×
Cost Index Value as of (B):				
	=	=	=	=
Specific Cost Estimate:	1000000	\$1,086,226	\$1,251,221	\$1,361,252
One-Time, Nondepreciable Expenditure				
Original Cost Estimate:				
	÷	÷		
Cost Index Value as of (A):				
	×	×		
Cost Index Value as of (B):				
	=	=		
Specific Cost Estimate:	\$100,000	\$108,623		

(A) -- Original Cost Estimate Date
(B) -- Specific Cost Estimate Date

OK Cancel

Reasons for modifying BEN's calculations can include the following, but be prepared to document your actions and rationale.

1. Separate Cost Estimates for Noncompliance and Compliance Dates

This could reflect several scenarios: the violator obtained a cost estimate at the noncompliance date, even though it did not comply until later; technological change between the noncompliance and compliance dates implies that different compliance measures were available at the two dates; or, regulatory change over time mandated different compliance measures at the noncompliance vs. compliance dates. Under such scenarios, use the most recent data for the original capital cost estimate so that it reflects the delay compliance scenario (ensuring that any future capital equipment replacement cycles are calculated correctly). Then, override the specific cost estimate in the first column (i.e., on-time scenario compliance start) with the correct estimate.

In the example below, the violator obtained a cost estimate for required capital investments of \$100,000 at the date of noncompliance (January 1, 1993), but because of technological change it only had to spend \$80,000 when it came into compliance on January 1, 1998. The user entered the \$80,000 estimate (with an estimate date of January 1, 1998) as the capital investment cost on 4th initial input screen. The specific cost estimate screen then appears as:

The screenshot shows a dialog box titled "Test Run: Specific Cost Estimates" with a close button (X) in the top right corner. The dialog is divided into two main sections: "Capital Investment" and "One-Time, Nondepreciable Expenditure".

Capital Investment Section:

	Compliance Start		Replacement Cycle Start	
	On-Time	Delay	On-Time	Delay
Compliance Start Date	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
Original Cost Estimate	\$80,000	\$80,000	\$80,000	\$80,000
Cost Index Value as of (A)	388.000	388.000	388.000	388.000
Cost Index Value as of (B)	357.200	388.000	446.936	486.239
Specific Cost Estimate	\$73,649	\$80,000	\$92,152	\$100,256

One-Time, Nondepreciable Expenditure Section:

	On-Time	Delay
Original Cost Estimate	\$100,000	\$100,000
Cost Index Value as of (A)	388.000	388.000
Cost Index Value as of (B)	357.200	388.000
Specific Cost Estimate	\$92,062	\$100,000

Legend: (A) -- Original Cost Estimate Date
(B) -- Specific Cost Estimate Date

Buttons: OK, Cancel

However, had the violator actually complied on time it would have faced a capital investment of \$100,000 (the estimate it received in 1993), not \$73,649 (the specific cost estimate as calculated from the 1998 estimate). To reflect this, the user changed the on-time compliance specific cost estimate to \$100,000.

Test Run: Specific Cost Estimates

	Compliance Start		Replacement Cycle Start	
	On-Time	Delay	On-Time	Delay
	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
Capital Investment				
Original Cost Estimate:	\$80,000	\$80,000	\$80,000	\$80,000
	÷	÷	÷	÷
Cost Index Value as of (A):	388.000	388.000	388.000	388.000
	×	×	×	×
Cost Index Value as of (B):	357.200	388.000	446.936	486.239
	=	=	=	=
Specific Cost Estimate:	100000	\$80,000	\$92,152	\$100,256
One-Time, Nondepreciable Expenditure				
Original Cost Estimate:	\$100,000	\$100,000		
	÷	÷		
Cost Index Value as of (A):	388.000	388.000		
	×	×		
Cost Index Value as of (B):	357.200	388.000		
	=	=		
Specific Cost Estimate:	\$92,062	\$100,000		

(A) -- Original Cost Estimate Date
(B) -- Specific Cost Estimate Date

OK Cancel

2. Inflation Data More Appropriate than BEN's

Although BEN offers many other alternative cost indices in addition to its default Plant Cost Index, occasionally some other inflation adjustment may be necessary. If so, override whichever specific cost estimates you believe are inaccurate. (If you are using some other index, you might want to create a spreadsheet that mimics the BEN screen, substituting your index's values for the ones on the screen.)

In the following example, the one-time nondepreciable expenditure consists mostly of chemicals. A subset of the Producer Price Index for chemicals will give a more precise inflation adjustment than the various indices BEN offers. You can use this chemical index to adjust the original cost estimate for inflation as shown in the table below:

Specific Cost Estimate Transportation Equipment Index		
	On-Time (1/1/1993)	Delay (1/1/1998)
Original Cost Estimate	100,000	100,000
	÷	÷
Cost Index Value as of original estimate date	111.0	111.0
	x	x
Cost Index Value as of specific cost estimate date	111.0	116.9
	=	=
Specific Cost Estimate	1,000,000	105,315

Once you have calculated the appropriate specific cost estimates, you can incorporate them into the BEN calculation by overriding the values on the specific cost estimate screen, as shown on the next page.

Test Run: Specific Cost Estimates

	Compliance Start		Replacement Cycle Start	
	On-Time	Delay	On-Time	Delay
	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
Capital Investment				
Original Cost Estimate:	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
	÷	÷	÷	÷
Cost Index Value as of (A):	357.200	357.200	357.200	357.200
	×	×	×	×
Cost Index Value as of (B):	357.200	388.000	446.936	486.239
	=	=	=	=
Specific Cost Estimate:	\$1,000,000	\$1,086,226	\$1,251,221	\$1,361,252
One-Time, Nondepreciable Expenditure				
Original Cost Estimate:	\$100,000	\$100,000		
	÷	÷		
Cost Index Value as of (A):	357.200	357.200		
	×	×		
Cost Index Value as of (B):	357.200	388.000		
	=	=		
Specific Cost Estimate:	\$100,000	105315		

(A) -- Original Cost Estimate Date
(B) -- Specific Cost Estimate Date

OK Cancel

Section A of this chapter provides guidance for addressing common arguments made by violators. Section B discusses how to characterize more complicated compliance scenarios.

A. COMMON VIOLATOR ARGUMENTS

- 1. *Cost of roof on new treatment building should be excluded since roof is not needed to operate treatment system.***

In virtually all cases BEN should include the cost of the roof unless the violator can conclusively prove that the treatment system would operate just as effectively and efficiently without the roof (all else being equal) and that the roof is not a customary part of such treatment systems. A violator can almost never support this claim, since it must essentially argue that installing a roof was a waste of money (serving no sensible business purpose).

- 2. *Cost of painting walls and landscaping treatment building should be excluded since they are unnecessary for compliance.***

While such items may not be directly necessary to achieve compliance, if these items are normally part of such projects, then BEN should include their costs. Such expenditures often provide intangible and tangible benefits, such as improving the appearance of the facility, reducing erosion and dust, preserving the building, and creating a more attractive environment for employees, visitors, and customers. Presumably these expenditures would have been necessary for on-time compliance, and hence the violator benefitted by delaying them.

3. *Cost of an extra (backup) pump should be excluded, since it is unlikely ever to be used.*

While the pump may never be used, if reasonable engineering practice would include an extra pump (or any other backup systems), then BEN should include its cost. Given that the violator did (or will) purchase the extra pump, the burden is on the violator to show that it is unnecessary to achieve and consistently maintain compliance. Further, even if the cost of the extra pump were subtracted from the capital investment, annual operation and maintenance costs might need to be increased to reflect the greater importance of maintaining the existing pumps.

4. *Cost of building second floor above treatment plant should be excluded since it is used exclusively for purposes unrelated to compliance.*

If the second floor does not support the pollution control system, then the incremental cost of building the second floor may be subtracted from the capital investment.

5. *Cost of building tertiary treatment system should be excluded since only primary and secondary treatment systems were necessary to remedy violations.*

If the tertiary treatment system really was unnecessary to prevent the violations alleged in the complaint, but rather is necessary for achieving compliance with future standards, then subtract its cost from the capital investment. Recall that the capital investment should reflect the pollution control system that was necessary to remedy the violations at the time and under the conditions alleged in the complaint. The violator, however, must convince EPA that the additional cost is truly unrelated to remedying the violations alleged in the complaint.

6. *No additional labor is necessary to operate new pollution control system, since existing employees operating old system will operate it.*

If the existing employees were operating an old pollution control system replaced by the new system, then this claim may be correct. Presumably the total labor costs associated with the old pollution control system (replaced by the new system) are less than or equal to the labor costs for the new system. If the new system is more efficient to operate, even less labor may be required. Your entry for annually recurring costs should reflect this and can even be negative.

7. *Labor costs for new system are really zero because we are reassigning workers from another part of plant; thus, since we are not hiring additional workers to run system, we have no incremental labor costs.*

This claim is not correct since the employees who will operate the new system are not coming from the old pollution control system that is being replaced. Rather, they are coming from another part of the facility and the facility will be deprived of the productive work these employees were doing. If the violator had complied on-time, it would have had to shift these employees to pollution control and given up the work these employees otherwise would have done somewhere else (e.g., the production line) during the period of noncompliance. This is the concept of opportunity cost: the cost of resources for a particular use is measured by the benefit lost in forfeiting their most profitable alternative use.

B. CHARACTERIZING COMPLIANCE SCENARIOS

1. *Violator Spends \$100,000 on System that Does Not Work.*

The violator should have spent \$1,000,000 to install a satisfactory system, but instead spent \$100,000 on-time for a system that did not work. If the system did not result in compliance, it is questionable that the system's expenditures were in fact intended for compliance. Unless some other factor is present, the correct entry for the capital cost should be \$1,000,000.

The enforcement team might find that the violator had some reasonable basis or justification for selecting the inexpensive technology. If the violator went to a reputable firm, the firm recommended the system that failed, and the violator's reliance on the recommendation was reasonable, then you should offset the economic benefit by the after-tax present value of the unsuccessful expenditure. You could use BEN to calculate this offset, although remember that this is a case-specific judgement for the litigation team.

2. *System "Works," But Is Too Small.*

The violator spent \$100,000 on-time for a system that was too small to solve the pollution problem, but the existing system can be incorporated into the final, fully sized system. The Agency should subtract from the total required investment the \$100,000 already spent; the BEN capital investment input would be \$900,000. The reason for this treatment is that the violator gained a benefit on only the \$900,000 that it did not spend, not the \$100,000 it did spend.

3. *Same as Scenario 2, But Violator Has Letter from Government Official Approving System.*

While the violator has a reason for being out of compliance, it still had the benefit of using the \$900,000 for other purposes while it was in violation. Thus, BEN's capital investment is still \$900,000. BEN is "no-fault" in nature. Regardless of how good the violator's excuse is, it still had the use of the \$900,000 over the period of the violation. The only difference between this and

scenario 2 is the existence of an arguable approval by the regulatory agency, but this is a legal distinction, not an economic one, possibly affecting the gravity component of the penalty, but not the economic benefit component.

4. *Violator Complies in Stages.*

The violator put part of the pollution system into operation (with actual pollution reduction) one year after the noncompliance date at a cost of \$200,000. One year later (and two years after the noncompliance date), the violator put a second piece of the system costing \$300,000 into operation (which resulted in additional pollution reduction). Three years later the entire system was in operation, and the final piece cost \$500,000.

If on-time compliance could have been achieved in one stage instead of three (see timeline below), create three separate BEN runs, each with the same noncompliance date:

- \$200,000 capital investment, and a one-year period of noncompliance;
- \$300,000 capital investment, and a two-year period of noncompliance;
- \$500,000 capital investment, and a three-year period of noncompliance.

As the violator paid for each component, it was no longer delaying the purchase of that equipment. Add the results from the three runs to determine the total economic benefit.

HYPOTHETICAL COMPLYING FIRM'S TIMELINE						
(not adjusted for inflation)						
7/1/93	7/1/94	7/1/95	<u>BEN's noncompliance date:</u>			
*	*	*	7/1/96			
		*	*			
		Decision to comply on-time	Expenditures for \$1,000,000			
NONCOMPLYING FIRM'S ACTUAL TIMELINE						
7/1/93	7/1/94	7/1/95	7/1/96	<u>BEN's compliance dates for:</u>		
*	*	*	*	<u>Run 1:</u>	<u>Run 2:</u>	<u>Run 3:</u>
				7/1/97	7/1/98	7/1/99
				*	*	*
				*	*	*
		Decision to comply in delayed fashion		Expenditures for Part A \$200,000	Expenditures for Part B \$300,000	Expenditures for Part C \$500,000

5. *System is Operational at Conclusion of Series of Expenditures.*

This is similar to scenario 4 (where the violator purchased and installed the various system components over three years), except that here the system is put into operation only after all of its components are installed, instead of sequentially.

You should create one BEN run with a capital investment of \$1,000,000 and a three-year noncompliance period. This assumes that on-time compliance would have been accomplished the same way as delayed compliance, in three separate stages. For both on-time and delayed compliance, three years are necessary to comply, and therefore if the violator had complied on time it would have needed to start three years before the compliance date.

HYPOTHETICAL COMPLYING FIRM'S TIMELINE (not adjusted for inflation)						
7/1/93	7/1/94	7/1/95	<u>BEN's noncompliance date:</u>			
*	*	*	7/1/96			
<hr/>						
Decision to comply on-time	Expenditures for Part A	Expenditures for Part B	Expenditures for Part C			
	\$200,000	\$300,000	\$500,000	System on-line		
NONCOMPLYING FIRM'S ACTUAL TIMELINE						
7/1/93	7/1/94	7/1/95	7/1/96	7/1/97	7/1/98	<u>BEN's compliance date:</u>
*	*	*	*	*	*	7/1/99
<hr/>						
			Decision to comply in delayed fashion	Expenditures for Part A	Expenditures for Part B	Expenditures for Part C
				\$200,000	\$300,000	\$500,000
						System on-line

Note that BEN's calculation here is based upon the simplifying assumption that all the money was spent on a single date, i.e., the day compliance was achieved. Instead of this simplifying assumption, you could instead create three separate BEN runs, with different noncompliance and compliance dates (yet hence the same-length noncompliance period). This will yield a slightly higher BEN result, although the additional complexity may not be worth the additional accuracy (especially if the noncompliance period is long relative to the period over which the actual expenditures are spread out).

6. *Pollution Control Equipment Will Be Leased, Not Purchased.*

The violator is actually leasing the equipment it needs to comply for \$125,000 per year. Rather than entering the \$1,000,000 as a capital cost, you should enter a zero for capital investment and \$125,000 as an annually recurring cost.

7. *Compliance is “Cheaper” than Noncompliance.*

The violator comes into compliance late and finds that it has been saving money since it installed the new technology. This may occur because the compliant technology allows the violator to recover materials and/or reduce operation and maintenance costs. BEN produces a negative result, seemingly confirming that the violator would have been better off had it complied on-time. Other factors may have caused the violator to delay compliance, or perhaps the violator was unaware not only of the potential cost savings from compliance but also the status of its noncompliance.

Be wary of such negative economic benefit results! For example, the violator might have felt that the new processes and technology needed to comply would have adversely affected its product quality. In that case, the violator probably realized an economic benefit from not having its product quality adversely affected by the compliant technology. This constitutes illegal competitive advantage, and typically requires additional research into the alternative compliance scenarios and their financial impacts.

Even if the economic benefit really is negative, the enforcement team should carefully consider the appropriate gravity component of the penalty, since the violations might still be serious, despite the lack of economic gain to the violator.

This technical appendix explains in detail how the BEN computer program calculates the economic benefit a violator gains from delaying or avoiding compliance with environmental regulations. The first section is an introduction to the theory and underlying assumptions of BEN. The second section is a step-by-step explanation of a sample economic benefit calculation.

A. THEORY AND OVERVIEW

Economic benefit represents the financial gains that a violator accrues by delaying and/or avoiding pollution control expenditures. Funds not spent on environmental compliance are available for other profit-making activities or, alternatively, a defendant avoids the costs associated with obtaining additional funds for environmental compliance. (This concept is known in economics as opportunity cost.) Economic benefit is “no fault” in nature: a defendant need not have deliberately chosen to delay compliance (for financial or any other reasons), or in fact even have been aware of its noncompliance, for it to have accrued the economic benefit of noncompliance.

The appropriate economic benefit calculation should represent the amount of money that would make the violator indifferent between compliance and noncompliance. (BEN implicitly assumes a 100-percent probability of the violator paying that sum of money in the form of a civil penalty, but as that probability declines, the amount of money increases that would make the violator indifferent between compliance and noncompliance.) If the enforcement agency fails to recover through a civil penalty at least this economic benefit, then the violator will retain a gain. Because of the precedent of this retained gain, other regulated companies may see an economic advantage in similar noncompliance, and the penalty will fail to deter potential violators. Economic benefit does not represent compensation to the enforcement agency as in a typical “damages” calculation for a tort case, but instead is the minimum amount by which the violator must be penalized so as to return it to the position it would have been in had it complied on time.

The economic benefit calculation must incorporate the concept of the “time value of money.” In simple terms, a dollar yesterday is worth more than a dollar today since yesterday’s dollar had

investment opportunities. Thus, the further in the past the dollar is, the more it is worth in “present value” terms. The greater the time value of money (i.e., the greater the “discount” or “compound” rate), the more value past costs have in present value terms.

Pollution control expenditures can include: (1) Capital investments (e.g., pollution control equipment), (2) One-time nondepreciable expenditures (e.g., setting up a reporting system, or acquiring land), (3) Annually recurring costs (e.g., operating and maintenance costs, or off-site disposal of fluids from injection wells). Each of these expenditures can be either delayed or avoided. BEN’s baseline assumption is that capital investments and one-time nondepreciable expenditures are merely delayed over the period of noncompliance, whereas annual costs are avoided entirely over this period. BEN does allow you, however, to analyze any combination of delayed and avoided expenditures.

BEN derives a violator’s economic benefit in several steps. First BEN adjusts compliance costs from the cost estimate date to the date when they would have been expended had the violator complied on time (on-time scenario) and to the date when they will be expended as the violator comes into compliance (delay scenario). Next BEN uses these costs to compute the total cost of complying on-time and of complying late, adjusted for inflation, depreciation and taxes. BEN also calculates the present value of both scenarios as of the date of initial noncompliance, so that they can be compared in a common metric. Then BEN subtracts the delayed scenario present value from the on-time scenario present value to determine the initial economic benefit as of the noncompliance date. Finally, BEN compounds this initial economic benefit forward to the penalty payment date.

A violator may gain illegal competitive advantages in addition to the usual benefits of noncompliance. These may be substantial benefits, but they are beyond the capability of BEN or any computer program to assess. Instead BEN asks you a series of questions about possible illegal competitive advantages so that you may identify cases where they are relevant. If illegal competitive advantage is an issue you should consult the EPA enforcement economics toll-free helpline at 888-ECON-SPT (326-6778) or benabel@indecon.com. If you need legal or policy guidance, please contact Jonathan Libber, the BEN/ABEL coordinator at 202-564-6102, or e-mail him at libber.jonathan@epamail.epa.gov.

B. CALCULATIONS AND SPREADSHEET

BEN references a Microsoft Excel™ spreadsheet to perform all of its economic benefit calculations, although you do not need Excel to run BEN. The data you enter into the program is automatically transferred to the spreadsheet. The spreadsheet calculates economic benefit and returns the result to the program for output. This section illustrates a BEN calculation by taking you step-by-step through relevant portions of the underlying spreadsheet. Italicized comments within brackets are added to explain the calculations, and are not part of the spreadsheet itself.

The spreadsheet is in your BEN folder (on your C drive or wherever else you installed BEN), filename "ben****.xls". (The asterisks represent the most recent year for which EPA has performed updates for the spreadsheet.) You may open the file, but it has been write-protected to preserve the integrity of the calculations. This spreadsheet contains necessary formulas and background information like tax rates, discount rates, and inflation indices. The background information will be updated once a year, but the calculations themselves will remain the same.

1. Inputs and Variables

The first section of the spreadsheet contains the variables entered by the user. These are a prerequisite for the calculations. The following page lists BEN's basic inputs, along with inputs from an example case.

Tax rates are contained in the spreadsheet as tables that contain corporate and individual tax rates and state tax rates from 1987 to 2010 (with rates for future years assumed to remain the same). Annual updates will keep tax rates current and add future years. When you designate a state and tax status for the violator, BEN finds the appropriate federal and state tax rates and calculates a combined tax rate. State taxes are deductible from federal taxable income, so the combined tax rate calculation is:

$$\text{Combined} = \text{Federal} + (\text{State} * (1 - \text{Federal})).$$

The spreadsheet also contains a table for the BCI, BEN, CCI, CPI, ECIM, ECIW and PCI inflation indices. (See Chapter 3 for a complete explanation of these difference indices.) Inflation indices are more precise than an annual inflation rate, but they require an index value for every relevant month. Therefore, BEN contains a database of monthly index values for every index from 1987 to 2029. Annual updates will keep indices current and add future values. For projected future inflation, BEN extrapolates each cost index forward in time at a separate forecasted rate, which is based upon a consensus forecast for the Consumer Price Index (CPI) and each individual index's historical relationship to the CPI. (The rationale for the calibration of the other indices to the CPI is that the CPI — yet not the more specialized indices — has widely available forecasts for projected inflation.)

Inputs	Example	Comments
Case Name	Example Case	
Analyst Name	Jon Analyst	
EPA Region	EPA Region I	
Tax Status	c-corp	<i>[Also known as "Entity Type"]</i>
State	MA	
Customized Tax Rates?	n	<i>[You may customize tax rates, in which case BEN will use the customized rates instead of its internal table]</i>
Penalty Payment Date (PPD)	01-Jan-2000	
Run Name	Test Run	
Discount/Compound Rate	10.7%	<i>[BEN calculates this from tax status, state, & relevant dates]</i>
Customized Discount/Compound Rate?	n	<i>[You may customize the discount rate]</i>
Customized Specific Cost Estimates?	n	<i>[You may customize the specific cost estimate screen]</i>
<u>Capital Investment:</u>		
Cost Estimate	\$1,000,000	
Cost Estimate Date	01-Jan-1993	
Cost Index for Inflation	PCI	<i>[You may choose from several indices]</i>
Cost Index Value	359.500	<i>[This is the index value as of the cost estimate date]</i>
Number of Replacement Cycles	1	<i>[This is the default value]</i>
Useful Life of Capital Equipment	15	<i>[This is the default value]</i>
Projected Rate for Future Inflation	1.7%	<i>[This is the default value]</i>
<u>One-Time, Nondepreciable Expenditure:</u>		
Cost Estimate	\$100,000	
Cost Estimate Date	01-Jan-1993	
Cost Index for Inflation	PCI	<i>[You may choose from several indices]</i>
Cost Index Value	359.500	<i>[This is the index value as of the cost estimate date]</i>
Tax Deductible?	Y	<i>[This is the default setting]</i>
<u>Annually Recurring Costs:</u>		
Cost Estimate	\$10,000	
Cost Estimate Date	01-Jan-1993	
Cost Index for Inflation	PCI	<i>[You may choose from several indices]</i>
Cost Index Value	359.500	<i>[This is the index value as of the cost estimate date]</i>
Noncompliance Date (NCD)	01-Jan-1993	
Compliance Date (CD)	01-Jan-1998	
Question 1	n	<i>[These are the competitive advantage questions. If you answer yes to any of them a warning that possible illegal competitive advantage exists appears in the results.]</i>
Question 2	n	
Question 3	n	
Question 4	n	
Question 5	n	
Question 6	n	

2. Discount/Compound Rate Calculation

Once the entity type and relevant dates have been entered, BEN can then calculate the violator's discount/compound rate. This is based on entity type and financial information from the date of noncompliance to the penalty payment date. (An industry- or company-specific discount rate can be calculated by experts, but cannot be calculated by BEN.) The discount/compound rate quantifies the time value of money. BEN discounts and compounds all cash flows at the cost of capital, averaged over the time period from the noncompliance date to the compliance or penalty payment date, whichever is later.

For a for-profit entity's discount/compound rate, BEN uses the weighted-average cost of capital (WACC) for a typical company, reflecting the cost of debt and equity capital weighted by the value of each financing source. A company must on average earn a rate of return necessary to repay its debt holders (e.g., banks, bondholders) and satisfy its equity owners (e.g., partners, stock holders). While companies often earn rates in excess of their WACC, companies that do not on average earn at least their WACC will not survive (i.e., their lenders will not receive their principal and/or interest payments, and their owners will be dissatisfied with their returns). The WACC represents the return a company can earn on monies not invested in pollution control, or, viewed alternatively, represents the avoided costs of financing pollution control investments. Thus, a company should make its business decisions by discounting cash flows at its WACC, and BEN follows the internal analysis a company will normally perform.

For a not-for-profit discount/compound rate, BEN uses a typical municipality's cost of debt, based on interest rates for general obligation bonds.

Discount/Compound Rate Calculation

Notes:

- (1) Corporate bond rates averaged across all industries; Federal Reserve Bulletin, Table 1.35.
- (2) Combined state/federal marginal tax rates: federal+(state*(1-federal)); Federation of Tax Administrators.
- (3) Calculated as: (1) * (100%-(2)).
- (4) Average corporate debt weight; Standard & Poor's Analyst's Handbook, S&P Industrials Sample Balance Sheet.
- (5) Federal Reserve Bulletin Table 1.35. [Used as a proxy for the risk-free rate in the Capital Asset Pricing Model (CAPM)].
- (6) Beta measures risk relative to overall stock market with a value of 1.00 therefore assuming risk is same as market.
- (7) Differences of average returns between stock market and 5-yr T-notes, 1926 - prior yr; Ibbotson Associates Handbook.
- (8) Calculated as (6) * (7). [Also equal to (7), since (6) is equal to 1.00 for a company of average risk.]
- (9) Calculated as (5) + (8). [Reflects risk-free rate of return plus the company risk premium.]
- (10) Calculated as 100% - (4). [Reflects: total financing - debt = equity financing.]
- (11) Calculated as (3) * (4) + (9) * (10). [Reflects: (debt cost x debt weight) + (equity cost x equity rate).]

YEAR	(1)	(2)	(3)	(4)	(5)	(6)	from: 1993		to: 2000		(10)	Equity Weight	Rate
							(7)	(8)	(9)	(11)			
	Cost of Debt	Tax Rate	After-Tax Debt Cost	Debt Weight	5-Year Treasury Notes	Beta	Intermed. Horizon Risk Prem	Company Risk Premium	Equity Cost	Equity Weight	Equity Weight	Equity Weight	Final Rate:
1987	9.9%	40.3%	5.9%	43.0%	7.94%	1.00	7.7%	7.7%	15.6%	57.0%	57.0%	57.0%	10.7%
1988	10.2%	40.3%	6.1%	52.0%	8.47%	1.00	7.3%	7.3%	15.8%	48.0%	48.0%	48.0%	
1989	9.7%	40.3%	5.8%	49.0%	8.50%	1.00	7.4%	7.4%	15.9%	51.0%	51.0%	51.0%	
1990	9.8%	40.3%	5.9%	50.0%	8.37%	1.00	7.8%	7.8%	16.2%	50.0%	50.0%	50.0%	
1991	9.2%	40.3%	5.5%	49.0%	7.37%	1.00	7.5%	7.5%	14.9%	51.0%	51.0%	51.0%	
1992	8.6%	40.3%	5.1%	47.0%	6.19%	1.00	7.7%	7.7%	13.9%	53.0%	53.0%	53.0%	
1993	7.5%	41.2%	4.4%	47.0%	5.14%	1.00	7.6%	7.6%	12.7%	53.0%	53.0%	53.0%	8.8%
1994	8.3%	41.2%	4.9%	44.0%	6.69%	1.00	7.6%	7.6%	14.3%	56.0%	56.0%	56.0%	10.2%
1995	7.8%	41.2%	4.6%	42.0%	6.38%	1.00	7.4%	7.4%	13.8%	58.0%	58.0%	58.0%	9.9%
1996	7.7%	41.2%	4.5%	37.0%	6.18%	1.00	7.8%	7.8%	14.0%	63.0%	63.0%	63.0%	10.5%
1997	7.5%	41.2%	4.4%	27.0%	6.22%	1.00	7.9%	7.9%	14.1%	73.0%	73.0%	73.0%	11.5%
1998	6.9%	41.2%	4.1%	25.0%	5.15%	1.00	8.2%	8.2%	13.4%	75.0%	75.0%	75.0%	11.1%
1999	7.5%	41.2%	4.4%	25.0%	5.55%	1.00	8.4%	8.4%	14.0%	75.0%	75.0%	75.0%	11.6%
2000	8.0%	41.2%	4.7%	25.0%	6.15%	1.00	8.5%	8.5%	14.7%	75.0%	75.0%	75.0%	12.2%

3. Specific Cost Estimates

After the compound/discount rate, BEN calculates specific cost estimates. This calculation adjusts costs from the cost estimate date to the date on which they should have been spent (on-time compliance scenario) and the date on which they will be spent (delay compliance scenario). These calculations are visible and may be altered on the specific cost estimates screen. (If the violator will avoid compliance completely, rather than simply delay it, you must modify this screen by changing the delay cost of compliance to zero.) The specific cost estimate calculations are shown below.

Calculations for Specific Cost Estimates

	Compliance Start:		Replacement Cycle Start:	
	<u>On-Time</u>	<u>Delay</u>	<u>On-Time</u>	<u>Delay</u>
Date:	01-Jan-1993	01-Jan-1998	01-Jan-2008	01-Jan-2013
<u>Capital Investment</u>				
Original Cost Estimate	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
	•	•	•	•
<i>PCI Value as of Cost Estimate Date,</i> <i>01-Jan-1993</i>	357.200	357.200	357.200	357.200
	x	x	x	x
<i>PCI Value as of Specific Estimate Date</i>	357.200	388.000	446.936	486.239
	=	=	=	=
Specific Cost Estimate,	\$1,000,000	\$1,086,226	\$1,215,221	\$1,361,252
reflecting implicit annualized inflation rate of:	N/A	1.7%	1.5%	1.6%
<u>One-Time, Nondepreciable Expenditure:</u>				
Original Cost Estimate	\$100,000	\$100,000		
	÷	÷		
<i>PCI Value as of Cost Estimate Date,</i> <i>01-Jan-1993</i>	357.200	357.200		
	x	x		
<i>PCI Value as of Specific Estimate Date</i>	357.200	388.000		
	=	=		
Specific Cost Estimate,	\$100,000	\$108,623		
reflecting implicit annualized inflation rate of:	N/A	1.7%		

Note that the specific cost estimate and the original cost estimate are the same here for the “Compliance Start: On-Time” scenario. This is because the cost estimate was made on the on-time date, so no inflation adjustment was needed.

4. Capital and One-Time Costs

Now BEN can calculate the total costs of compliance for both scenarios. First it calculates the costs of compliance as of the on-time and delay scenarios. Then BEN adjusts both sets of costs to the noncompliance date so that they can be compared to each other.

Each scenario is divided into an initial cycle and a replacement cycle. The initial cycle covers the cost of installing equipment, while the replacement cycle covers the cost of replacing that equipment when its useful life is over. The number of replacement cycles defaults to one, and the useful life of equipment defaults to fifteen years.

Because of the time value of money, the farther in the future costs are, the less value they have in present terms. Therefore, replacement cycles after the first one have almost no impact on economic benefit. They are cumulatively calculated from the value of the first replacement cycle.

The present value (as of the noncompliance date) of each date's cash flow is equal to the cash flow multiplied by that date's present value factor. The PV factor uses the discount/compound rate to determine a dollar's equivalent value in noncompliance date dollars. Therefore, the PV factor for any date is equal to the sum of one plus the discount/compound rate, raised to the difference in the number of years (including any fractions) between that date and the noncompliance date.

A) On-Time Capital & One-Time Costs: Initial Cycle

	01-Jan-1993	01-Jul-1993	01-Jul-1994	01-Jul-1995	01-Jul-1996	01-Jul-1997	01-Jul-1998	01-Jul-1999	01-Jul-2000	
One-Time, Nondepreciable Expenditure	(100,000)	<i>[From specific cost estimates]</i>								
Capital Investment	(1,000,000)	<i>[From specific cost estimates]</i>								
Depreciation	0	(142,900)	(244,900)	(174,900)	(124,900)	(89,300)	(89,200)	(89,300)	(44,600)	
Marginal Tax Rate	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	
Net After-Tax Cash Flow	(1,058,800)	58,875	100,899	72,059	51,459	36,792	36,750	36,792	18,375	
PV Factor: Adjusts Cash Flow to NCD	1.0000	0.9508	0.8589	0.7759	0.7007	0.6330	0.5718	0.5165	0.4665	
PV Cash Flow as of NCD	(1,058,800)	55,981	86,665	55,911	36,058	23,289	21,014	19,004	8,572	

Net Present Value (NPV) as of NCD:

Initial Cycle	(\$752,306)
Subsequent Replacement Cycles	(\$188,735)
Total -- All Cycles	(\$941,041)

[Companies may deduct the depreciation of capital equipment from their taxable income. Below is the standard 7-year depreciation schedule, using the half-year convention.]

Depreciation (MACRS):	14.29%	24.49%	17.49%	12.49%	8.93%	8.92%	8.93%	4.46%
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B) Delay Capital & One-Time Costs: Initial Cycle

	01-Jan-1998	01-Jul-1998	01-Jul-1999	01-Jul-2000	01-Jul-2001	01-Jul-2002	01-Jul-2003	01-Jul-2004	01-Jul-2005	
One-Time, Nondepreciable Expenditure	(108,623)	<i>[From specific cost estimates]</i>								
Capital Investment	(1,086,226)	<i>[From specific cost estimates]</i>								
Depreciation	0	(155,222)	(266,017)	(189,981)	(135,670)	(97,000)	(96,891)	(97,000)	(48,446)	
Marginal Tax Rate	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	
Net After-Tax Cash Flow	(1,150,096)	63,951	109,599	78,272	55,896	39,964	39,919	39,964	19,960	
PV Factor: Adjusts Cash Flow to NCD	0.6014	0.5718	0.5165	0.4665	0.4214	0.3807	0.3439	0.3105	0.2805	
PV Cash Flow as of NCD	(691,632)	36,568	56,612	36,512	23,554	15,213	13,727	12,411	5,599	

Net Present Value (NPV) as of NCD:

Initial Cycle	(\$491,437)
Subsequent Replacement Cycles	(\$123,433)
Total -- All Cycles	(\$614,870)

A) On-Time Capital & One-Time Costs: First Replacement Cycle

	01-Jan-2008	01-Jul-2008	01-Jul-2009	01-Jul-2010	01-Jul-2011	01-Jul-2012	01-Jul-2013	01-Jul-2014	01-Jul-2015
One-Time, Nondepreciable Expenditure	0								
Capital Investment	(1,251,221)	[Zero because this is the replacement cycle, and one-time costs do not occur again by definition]							
Depreciation	0	(178,799)	(306,424)	(218,839)	(156,278)	(111,734)	(111,609)	(111,734)	(55,804)
Marginal Tax Rate	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%
Net After-Tax Cash Flow	(1,251,221)	73,665	126,247	90,161	64,386	46,034	45,983	46,034	22,991
PV Factor: Adjusts Cash Flow to NCD	0.2175	0.2067	0.1868	0.1687	0.1524	0.1376	0.1243	0.1123	0.1015
PV Cash Flow as of NCD	(272,118)	15,229	23,577	15,210	9,812	6,335	5,717	5,170	2,332

Total NPV of First Replacement Cycle as of NCD (\$188,735)

"i", where $i = (1 + \text{futureinflation}) / (1 + \text{discount rate})$

"u", where u = useful life of capital equipment

"n", where n = number of replacement cycles

"f", where f = sum [from i = 1 to i = n] of: $r^i (u * (i-1))$

Total NPV of All Replacement Cycles as of NCD

1.0000 *This is where the value of future replacement cycles is calculated*

(\$188,735) = f * First Replacement Cycle

Depreciation (MACRS):	14.29%	24.49%	17.49%	8.93%	8.92%	8.93%	8.93%	8.93%	4.46%
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B) Delay Capital & One-Time Costs: First Replacement Cycle

	01-Jan-2013	01-Jul-2013	01-Jul-2014	01-Jul-2015	01-Jul-2016	01-Jul-2017	01-Jul-2018	01-Jul-2019	01-Jul-2020
One-Time, Nondepreciable Expenditure	0								
Capital Investment	(1,361,252)								
Depreciation	0	(194,523)	(333,371)	(238,083)	(170,020)	(121,560)	(121,424)	(121,560)	(60,712)
Marginal Tax Rate	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%	41.2%
Net After-Tax Cash Flow	(1,361,252)	80,143	137,349	98,090	70,048	50,083	50,027	50,083	25,013
PV Factor: Adjusts Cash Flow to NCD	0.1308	0.1243	0.1123	0.1015	0.0916	0.0828	0.0748	0.0675	0.0610
PV Cash Flow as of NCD	(177,984)	9,964	15,425	9,951	6,418	4,145	3,740	3,382	1,526

Net Present Value (NPV) as of NCD:

Total NPV of First Replacement Cycle as of NCD (\$123,433)

Total NPV of All Replacement Cycles as of NCD (\$123,433) [Calculated using the same formula as on-time all replacement cycles above]

5. Avoided Annually Recurring Costs

Annual costs are avoided, not merely delayed. Therefore BEN does not need to calculate and compare two different scenarios for annual costs. Instead, it computes the costs avoided each year, then adjusts those costs to the noncompliance date. Finally it adds the present values of the costs avoided each year to compute the total net present value of avoided costs.

C) Avoided Annually Recurring Costs

<i>PCI value as of cost estimate date= 357.200</i>						
	<i>PCI mid-point value:</i>	359.400	368.000	381.900	381.800	387.100
Period of Avoided Annual Costs; From:	01-Jan-1993	01-Jan-1994	01-Jan-1995	01-Jan-1996	01-Jan-1997	
	To:	31-Dec-1993	31-Dec-1994	31-Dec-1995	31-Dec-1996	31-Dec-1997
Annual Costs Avoided		(10,062)	(10,302)	(10,691)	(10,718)	(10,837)
Marginal Tax Rate		41.2%	41.2%	41.2%	41.2%	41.2%
Net After-Tax Cash Flow						
		(5,916)	(6,058)	(6,287)	(6,302)	(6,372)
PV Factor: Adjusts Cash Flow to NCD		0.9506	0.8587	0.7757	0.7006	0.6328
PV Cash Flow as of NCD		(5,624)	(5,202)	(4,876)	(4,415)	(4,032)
NPV of Avoided Annual Costs as of NCD		(\$24,150)				

Note that BEN determines the cost index value for the midpoint of the period in question to account for inflation. BEN also adjusts the annual cost for any partial years.

6. Economic Benefit Results

Now that BEN has computed the present values (PVs) of complying on-time and complying delayed, it compares the two. Economic benefit is the PV of complying on-time, minus the PV of complying delayed, plus the PV of the avoided annually recurring costs. The initial economic benefit is calculated as of the noncompliance date, and then brought forward to the penalty payment date at the discount/compound rate.

The initial economic benefit is multiplied by the sum of one plus the discount/compound rate, raised to the difference in the number of years (including any fractions) between the noncompliance and penalty payment dates.

Run Name = Test Run		
<u>Present Values as of Noncompliance Date, 01-Jan-1993</u>		
A) On-Time Capital & One-Time Costs	\$941,041	<i>[Sum from on-time scenario calculations]</i>
B) Delay Capital & One-Time Costs	\$614,870	<i>[Sum from delay scenario calculations]</i>
C) Avoided Annually Recurring Costs	\$24,150	<i>[Sum from avoided annually recurring cost calculation]</i>
D) Initial Economic Benefit (A-B+C)	\$350,321	<i>[Economic benefit as of the date of noncompliance]</i>
E) Final Econ. Ben. at Penalty Payment Date,		
	<u>01-Jan-2000</u>	<u>\$713,872</u> <i>[Final result, economic benefit as of the penalty payment date]</i>